INDIAN INDUSTRIAL GUIDE

BEING

A HAND-BOOK OF READY REFERENCE CONTAINING VARIOUS SUGGESTIVE INFORMATION AND PRACTICAL HINTS NCERNING TRADE, COMMERC INDUSTRIES, AGRICULTURE &c. &c. &c.

BY

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OF THE PROVINCIAL CIVIL SERVICE

(E. B. & A.)

WITH AN INTRODUCTION

BY

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PREFACE.

The present work pretends to little originality: nor does it profess in any way to be an exhaustive compilation. It is but a modest attempt at bringing, within a narrow compass, some of the salient points regarding the agriculture, minerals and industries of this country—upon which, volumes have been written and may yet be written from time to time by experts.

The need, however, of a suggestive, but handy, compendium is keenly felt by a practical student of the busy work-a-day world.

I know of many who possess the means and necessary qualifications, but who nevertheless feel hopelessly puzzled as to the way their money and labour should be employed with profit to themselves and their country. This state of uncertainty particularly forced itself into my mind when I found myself unable to decide what to do with my younger brother who had just failed to graduate. Who can deny that there are many similarly situated at the present time?

For the last 5 years, my attention has been engaged on this subject, and the present publication is the outcome of a laborious compilation from various sources.

No pains have been spared to make the book practical and really useful as a guide. With this object in view, elaborate academic discussions have been avoided—while, prominence has been given to such informations or tit-bits as are likely to create an interest in the economic and commercial aspects of the subject concerned or furnish a clue to the same.

Should these pages prove helpful to a single individual in starting one new industry in the country or in determining the course of action to be adopted by him in life, I shall consider my hours as amply rewarded.

I am conscious that, compiled as the book has been in the short intervals snatched from a busy official life, the arrangement of the subjects, considering the vast range of them that has been dealt with—or the mode of their treatment may have left much to be desired. That I have been able to issue the book at all is due entirely to the generous and cordial assistance of two of my friends in Calcutta, Mr. P. K. Roychowdhury Bar-at-Law and Mr. Monorathadhan De, M.A. Principal, Uttarpara College, who at considerable personal sacrifice so cheerfully looked over the proofs and press work generally for months together. My heart-felt thanks are due to both of them.

I take this opportunity also to acknowledge my obligations to the numerous authors, publishers and writers in newspapers and magazines, in English as well as Bengali from whose writings I have largely drawn in making this compilation.

I intend to make this the foundation and beginning of a line of work which, I am inclined to hope, will prove of interest to the Industrial and Agricultural regeneration—which is the true regeneration—of this country so rich in natural resources.

December, 1906. D. R. GHOSE.

INTRODUCTION.

The want of a handy compendium of Indian industries and agriculture is keenly felt. For the last twenty years, patriotic gentlemen have been writing on these subjects. The author has in this book brought all available information within a short compass. He has thus done a great service to the country.

The necessity of improved agriculture and industry for the amelioration of the condition of the people of this country need not be dilated upon. But, for that, knowledge and energy are needed. Resolutions are good in their way, but, they must be followed by action.

This book will show the way to many who desire to follow the path of agriculture and industry—the path of the true regeneration of the country. It contains information about every tree and plant and herb of this country—the garden of the world—which may bring wealth to her people. It contains information about possible industries which may be started in this country.

The people of India are moral, temperate and frugal. The country is richer than any other country in natural resources. We can certainly compete with the peoples of other countries in the industrial war and beat them. Japan is making rapid progress in commercial and industrial matters and has taken her place among the foremost nations of the earth. The Japanese are half in number the popu lation of Bengal and very much poorer. What is it that has made them what they are? Energy and earnestness of purpose, avoidance of much talk,in short, steady silent work. They have put their shoulders to the wheel of the progress of their country with a will and self-sacrifice which there is no reason why we also should not be capable of.

What we lack is definite object,—we have no clear cut ideas before us. We must descend from the heights of theories to the sun-lit fields of this the fairest land on earth, where the cultivator toils and to the factory where the artisan works—regardless of the noise made in a thousand platforms. We must go and work with them. If we cannot toil in the field, we must give those that work there such information and knowledge obtained from the science of this and other countries as we may collect. We, too, may toil and work for the progress of our country.

Babu Dakshina Ranjan Ghose in the midst of his arduous official duties has toiled and worked for our good. He has produced a book the utility of which will be patent to the most casual reader of these pages. Information about everything concerning the agriculture and industries of the country is here. The country has every reason to be thankful to the author for this timely publication.

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THE INDIAN INDUSTRIAL GUIDE.

THE WEALTH OF 'IND.'

"India the mine of wealth !! It has wonderful natural resources, whether agricultural, mineral, or industrial, but they are to a great extent dormant. It has coal of an excellent quality : it has fine petroleum, large quantities of timber and charcoal : it has iron, of a purity that would make an English iron-master's mouth water, spread wholesale over the country in most places to be had by light quarrying over the surface : it has chrome iron capable of making the finest Damascus blades, manganiferous ore, splendid hematites in profusion. It has gold, silver, antimony, tin, copper, plumbago, lime, kaolin, gypsum, precious stones, asbestos : soft wheat, equal to the finest Australian, hard wheat, equal to the finest Kabanka. It has food-grains of every description : oil-seeds, tobacco, tea, coffee, cocoa, sugar, spices, lac, dyes, cotton, jute, hemp, flax, coir, fibres of every description : in fact, products too numerous to mention. Its inhabitants are frugal, thrifty, industrious, capable of great physical exertion, docile, easily taught, skilful in any work requiring delicate manipulation. Labour is absurdly cheap, and the soil for the most part wonderfully productive."

SIR GUILFORD MOLESWORTH, K. C. I. E.

——:o:——

"Were India wholly isolated from] the rest of the world, or its mineral productions protected from competition, there cannot be the least doubt that she would be able, from within her own boundaries, to supply nearly all the requirements of a highly civilized community."

BALL'S "ECONOMIC GEOLOGY OF INDIA."

——:o:——

"There are also available in India millions of potential horse power, in the form of water flowing from the mountain ranges, capable of being converted into electrical energy at generating stations near the hills, and conveyed with slight loss to centres even at very great distances, where it can be utilized for industrial purposes. There is plenty of capital in India." "India in poverty !! Midas starving amid heaps of gold does not afford a greater paradox ; yet here, we have India, Midas-like, starving in the midst of untold wealth."

SIR GUILFORD MOLESWORTH, K. C. I. E.,

——:o:——

THE ECONOMIC PROBLEM OF THE DAY.

"The desire to see the country economically independent will not be accomplished by merely patriotic demonstrations against foreign goods. Their importation can be prevented only by the manufacture in this country materials of the same quality at lower rates or of better materials at the same price. To do this enterprise is wanted more than self-sacrifice—enterprise on the part of students willing to take up technical subjects instead of law, philosophy and literature ; enterprise on the part of capitalists ready to invest intelligently in industries now taxed by borrowed capital."

"Our poverty is not in material, but in men capable of turning the natural material into the finished product. We want more than Government provision for technical scholarships : we want a *reformation in the tastes* of our students : we want them to learn that the man with technical dexterity is of more use to the country than the writer of editorials or the skilful cross-examiner ; that applied science now belongs to the hightest caste of learning, and is a worthy field for the best ability we can obtain."

"As far as our mineral resources are concerned, there is unlimited room for profitable enterprise : the country is sufficiently endowed by Nature, not only to meet its own requirements, but to take advantage of its central position for competing with others in the Indian Ocean markets ; but until we find the chemical, metallurgical and mechanical workshops as attractive to our high-caste students as the class-rooms for law and literature now are, the cry of Swadeshi, no matter how worthy the spirit it embodies, will remain but an empty word."

T. H. Holland, F. R. S.

Director-General of the Geological Survey of India.

——:o:——

"The material progress and redemption of India lies, to my mind, primarily in industry, secondarily only, in politics.

Progress in politics is bound to follow on the heels of material progress. It can never come as an antecedent. To the man who has to struggle year in and year out to gain daily bread for his family and for himself, it matters little under what form of Government he lives."

"If we believe that the salvation of India lies in the mill and in the farm rather than in the forum and the lecture-hall, it is incumbent upon each one of us to do what in him lies to improve the conditions and methods of agriculture and handicraft."

J. Hope Simpson, I. C. S.,

At the Industrial Conference, Benares, 1905.

——:o:——

"Our industrial condition in the present day is lamentable, but it is not hopless. We have to face a severe, and in some respects an unequal, competition, but our future is in our own hands if we face our difficulties like men."

"We are beset with grave difficulties but we have no reason to despair.

In the first place, we have lagged behind, and have to recover lost ground. And in the second place, we have to run the race with the triple disadvantage of want of modern industrial training, want of capital, and want of control over our own fiscal legislation.

I mention these difficulties not to discourage you but because we have to face and conquer them. Few countries on earth would have succeeded under these difficulties, but I have faith in the capacities of our nation, in the patience and skill of our artisans, in the adaptability of our race to new methods, in the resources of this wonderful land and in the advantages of cheap labour. I have been something of an optimist all my life ; I think it better to fight and to fail than not to fight at all ; but in this industrial movement, I believe we are destined to fight and to conquer."

R. C. Dutt, C. I. E.,

President of the First Indian Industrial Conference, Benares, 1905.

PART I.

AGRICULTURE AND ECONOMIC PRODUCTS

THE INTERNATIONAL INSTITUTE OF AGRICULTURE OF INDIA

Early in 1905 the King of Italy took the initiative for the establishment of an International Institute of Agriculture. The following nations, among others, have signified their adherence to the scheme:—America, France, Japan, Russia, Denmark, Switzerland, Holland, Spain, Portugal, Servia, and Argentina. The aims of the Institute are twofold. Its first and main service will lie within the field of the economies of distribution. It is pointed out that most of the staple products of the soil have a world-wide market. The prices of such commodities are continually varying from a number of unseen causes. The condition of the crops in any single country will affect the prices in every market in the world. Each contracting Government engages to adopt a uniform and adequate system of gathering and reporting crop statistics. Such knowledge, obtained, not from speculators, whose main interest is to influence the market, but on official authority, would not only ensure a more economic distribution of the staple products—wheat, cotton, etc., but would furnish a sure and automatic means of fixing prices according to supply and demand. Though it is not apparent that Great Britain has yet given her accord to the scheme, it is to be hoped that with our great wheat producing interests we will fall in with the scheme. The authoritative statistics gathered by the Institute should be of the greatest use to Indian agriculturists in bringing the wheat production of the world under review.

SIR WILLIAM CROOKES ON OVER-POPULATION IN WESTERN COUNTRIES AND WHEAT AND COMBINED NITROGEN

It is now more than five years since Sir William Crookes uttered a warning note that the population of the world is increasing so rapidly that the supply of wheat will shortly not be sufficient to

feed it. "When provision shall have been made, if possible, to feed 230,000,000 units likely to be added to the bread-eating populations by 1931, where can be grown the additional 330,000,000 bushels of wheat required ten years later by a hungry world?" While the staple food of Europeans is wheat, wheat it its turn requires food, and the food, without which it cannot grow, is combined nitrogen. Now soil contains nitrogen in the form of nitrates; as also certain plants. Another source of combined nitrogen is sewage; but we have embarked on a course of water carriage for the elimination of our sewage from towns; and this precludes the economical use of its nitrogen for manurial purposes. Whether this policy is right is open to grave doubt; but of the fact that we have decided on that policy there is no question. "When Lord Rayleigh showed, now eleven years ago, that atmospheric nitrogen is denser than nitrogen produced by chemical means from one of its compounds, he and Sir William Ramsay showed that the cause is to be traced to the existence of a gas in air, heavier than nitrogen to which the name of argon was given. To prepare argon in quantity it was necessary to remove the nitrogen; and a process, depending on the rapid absorption of nitrogen by the metal magnesium, was employed, and it proved to be the most convenient for the object in view. There are two practicable ways of causing this nitrogen to enter into combination. The first is to absorb it by some metal, or by some metallic absorbent; the second to cause it to unite with oxygen and to absorb the compound in alkali. An ingenious suggestion has been made by Professor Guye, of Geneva, namely, that both the processes should be worked in concert for it would then be possible to provide chiefly pure nitrogen for the former process and rich oxygen for the latter. The present source of combined nitrogen is sodium nitrate or "Chilli saltpetre;" it is found on the eastern slopes of the Andes in a narrow zone barely two miles in breadth. The present export is about a million and-a-half tons a year, valued at £16,000,000; it is doubtful if the deposit will last beyond the year 1950. Combined nitrogen is also procured in large quantities by passing through water the gases from coke furnaces. But these sources are limited and if wheat is to be grown in sufficient quantity to supply food for Western nations, the artificial production of nitrates is an absolute necessity. Its achievements prevent the threatened suppression of the wheat-eaters by the rice-eaters and maintains the supremacy of Western civilization.

THE APPLICATION OF SCIENCE TO AGRICULTURE

FIXATION OF NITROGEN

A highly interesting and instructive lecture was delivered recently by Mr. J. B. Guthrie before the Sydney University Extension Board, on the application of science and of scientific method to agriculture, which is published in January number of the "Agricultural Gazette" of New South Wales, from which we quote the following remarks on the fixation of nitrogen etc., which may prove of interest to some of our readers:—

Among special questions the study of which has resulted in most important advantages to the growth of agriculture is that of the plant's supply of nitrogen. We owe the solution of this question to the science of bacteriology. It had long been known that the addition to sterile soils of relatively small quantities of other soils was capable of rendering the former fertile. This was found to be accompanied by an increase in the amount of nitrate (salts of nitric acid). The discovery by Pasteur of organisms inducing different kinds of fermentation showed the way to a rational understanding of this phenomenon. Pasteur himself surmised that this gain in nitrates was brought about by the development of micro-organisms. In 1878 Schloesing and Muntz in France were able to prove that this was the case, and that certain nitrifying organisms were capable of converting ammonium salts in the soil into nitrates. These organisms were isolated by Winogradsky, who separated two distinct groups one of which converts the ammonium compounds into nitrites, while the second carries the oxidation a stage further, and produces nitrates.

The question whether plants are able to absorb the nitrogen of the air directly by means of their leaves was, for a long time, a vexed one, and nearly every investigator of distinction gave his attention to this subject. The question can hardly be said to be definitely cleared up to-day, but the theory now accepted is that plants do not absorb nitrogen by means of their leaves, but that one class of plants, the leguminosae, have the power of assimilating by means of their roots, the free nitrogen contained in the interstitial air within the soil. The German chemists, Hellriegrel and Willfarth, were the first to establish this highly interesting and important fact and they proved that true assimilation was effected by the agency of bacteria inhabiting the root nodules of

leguminous plants such as clovers, peas, etc.

These investigations have not only been of the very greatest value in enabling us to understand the principles underlying such operations as the rotation of crops, and to place them upon a systematic basis but they bid fair to indicate a means of directly increasing the fertility of the soil by the direct application of the organisms involved.

Many attempts have been made to prepare pure cultures of some of these nitrifying organisms, and to inoculate the soil with them. The most successful attempts have been with the root-nodules of leguminous plants. Professor Nobbe, of Saxony prepared cultures of these bacteria, which were and are still on the market under the name of "Nitragin". These have been used often with success for inoculating soil on which the host plants did not make good growth. More recently Dr. Moore, of the United States Department has prepared by a somewhat different process, cultures of these organisms, which it is claimed have produced the most remarkable results in farm practice. It is yet rather early to pronounce on the success or non-success of these cultures. They are being experimented with probably by every agricultural department or station in the world.

The free nitrogen of the air can then be utilised directly by certain plants in the manner mentioned. The majority of cultivated plants, however derive their nitrogen from nitrates and ammonium salts in the soil. A point of the very greatest importance to us is—can we by any means reproduce artificially this nitrogen absorption? Can we convert atmospheric nitrogen into a form in which it can be absorbed by the plant? The importance of this question is enormous, for nitrogen is one of the substances which is absolutely essential to plant growth, and is one which most crops (legumes excepted) have a difficulty in utilising in the form in which it is present in the soil. It is, therefore, continually applied in manure. Substances like stable manure, blood, bone-dust, sulphate of ammonia, and nitrate of soda, owe their efficiency to the nitrogen they contain. But nitrogen is a very difficult substance to catch and force into combination with other elements. In the air as you know, it exists in the free state, and it is characterised by a highly aristocratic exclusiveness,—a strong disinclination to mix with socially inferior elements,—a characteristic which is so marked that even when it has been coaxed into combination—such, for example, as nitro-glycerine, nitro-cellulose, picric acid,

etc.,—it liberates itself on the slightest provocation with violent explosion. On account of this aloofness, it has not yet been possible to devise a means by which atmospheric nitrogen can be made to combine readily and cheaply in such a form as to be available for plant-food when applied to the soil.

Recently, however, what looks like a possible solution of the question has been discovered. When air, from which the oxygen has been removed, and which may be regarded as practically pure nitrogen, is passed over claimed carbide at a white heat, it combines, forming a compound known as calcium cyanide. This is a fine black powder which is decomposed by water into ammonia.

The crude cyanide has been found to possess manurial value, due no doubt, to the liberation of ammonia by the soil-moisture. Too few experiments have as yet been tried with this substance to settle the points as to whether it is likely to be an effective substitute for sulphate of ammonia.

Dr. Hall, of the Rothamstead station, has reported a trial with mangels, swedes, and mustard. He reports that the trials do not warrant any definite conclusion as to its comparison with sulphate of ammonia for example, but finds it to be an effective nitrogenous manure. But even if we have not yet got the desired substance, there is little room for doubt that experiments along this line will result in the preparation of a cheap fertiliser from the practically limitless expanse of air. English people will be pleased to hear that there is already a company, connected with the Cyanid Geselschaft in Berlin, where this substance is being prepared—at present, only at the rate of about one ton per day.

Another method by which attempts are being made to obtain a cheap supply of nitrate from the air is by means of electricity. As you are aware when air is "sparked," nitric acid is formed by the direct union of the nitrogen and oxygen. This happens always in th neighbourhood of electrical machines, and during storms the flashes of lightning cause this combination; so that the air during a thunderstorm always contains small quantities of nitric acid. Attempts are being made to utilise this action on the manufacturing scale, converting the nitric acid so formed into nitrate of soda.

The solution of this problem is simply a question of cheapening the unit cost of the electric current. Sir William Crookes has calculated that if the cost could be reduced to 1-17*d.* per Board of Trade unit, what is quite possible when large natural sources of

power like Niagara are used, the cost of nitrate of soda need not be more than £5 per ton. Up to now it has not been possible to manufacture "electric nitrate" at a rate to compete with the natural nitrate of soda.

A correspondent writes in the "Madras Mail:" Since I last wrote on this subject particulars have come to hand of a lecture delivered at the Royal Institution in London by Professor Sylvanus Thompson, on "Electric Production of Nitrates from the Atmosphere," The lecturer referred to Messrs. Birkelande and Eyde's enterprise in Norway and thus deseribed the process of manufacture:—"In a special electric furnace, an alternating electric arc was produced at between 3,000 and 4,000 volts, and was formed between the poles of an electro-magnet which forced it to take the shape of a disc of roaring flame, four or five feet in diameter. Ordinary air was blown through the furnace, and emerged charged with nitrous fumes, the rapidity with which the product was removed from the sphere of operations being an important element. The nitrous fumes were collected, allowed time to oxidise still further, and then absorbed in water-towers or in quicklime. Experiment showed that the nitrate of lime produced was as good a fertiniser as Chilli - saltpetre." That it can be produced on a commercial scale is due to the special conditions in Norway, where it is estimated that electric power can be produced at about a fortieth of a penny per unit. The lecture was illustrated with a large number of slides illustrating the Birkeland-Eyde factory at Notodden and the research station near Arendal, and the peculiar form of electric discharge used was shown by a model apparatus sent from Christiania.

They have also a method of fixing the nitrogen of the air in Germany, known as the chemical process of Professor Eschweiler, of Hanover. This, it is said, is also being adopted in England, and consists in passing a mixture of air and steam over peat in slow combustion. The steam is decomposed, the hydrogen combining with the nitrogen of the air and of the peat to produce ammonia. This is taken up by sulphuric acid, forming sulphate of ammonia, and it is claimed that enough can be produeed at moderate cost to avert a fertiliser famine for a long time.

SOIL INOCULATION WITH NITROGEN-FIXING BACTERIA: A WONDERFUL DISCOVERY: HISTORY OF DEVELOPMENT

One of the greatest triumphs of modern Chemistry is the preparation of a powder to enrich barren soil. Thanks to the researches of the Botanical Department of the United States, the land-holders have been supplied with such powders and, by a process of vaccination, they are obtaining from what was barren soil heavy crops. A German of enquiring mind may be said to be the father of the new discovery. He solved the mystery why certain plants enrich the land, while others exhaust. He found that peas, beans &c., obtained their nitrogen food, not from the nitrates in the soil but from the free supply in the air. He also discovered that these plants absorbed much more nitrogen than they could use and left the surplus in the soil. That is, beans, peas, alfalfa, clover, put back into the mother-earth what corn and wheat grains remove. After much labour he isolated the *nitrogen-fixing-bacteria.* He succeeded in breeding and colonising the germs, and then proceeded to put them on the market. They failed, however, to produce the desired results.

At this point the inventive genius of an American, *Dr. George T. Moore*, came to the rescue, and saved the discovery by giving it just the practical value it had lacked. Dr. Moore is in charge of the Laboratory of Plant Physiology of the Department of Agriculture, and a widely known practical botanist. He developed a permanent type of bacteria in his laboratory, possessing five or ten times more power to fix free nitrogen than the original germs had possessed. The bacteria had gained strength, vigour, and self-sacrifice, and when turned out of the laboratory, prospered like all healthy bacteria. Dr. Moore also discovered that by using some absorbent, like cotton, a small piece of which will soak up millions of the organisms, and then by allowing these cultures to become dry, the bacteria can be sent to any part of the world and yet arrive in perfect condition. Packets of the bacteria have been sent to thousands of American farmers with directions for use. A solution of water and mineral salts is prepared, and with this solution the seeds are moistened. To inoculate the soil the farmer is advised to wet a quantity of dry earth and then spread it thinly over the field exactly as if using a fertiliser. Enough germs are sent in each little package to inoculate seeds for from one to

four acres. The package can be carried in your pocket, and yet *does more work than several cart-loads of fertiliser.* It costs the government *less than four cents a cake, or less than a cent an acre,* and saves the farmer thirty or forty dollars, which he would have to spend for an equal amount of fertilizer. Different cultures are sent for different crops.

The results of the experiment have been thus described by an American paper:—

"Two patches of hairy vetch, grown, side by side under precisely the same coditions, yielded crops as follows: uninoculated patch, 581 pounds; inoculated patch, 4,501 pounds—an increase of more than eight times. Crimson clover under similar conditions yielded uninoculated, 372 pounds; inoculated, 6,292 pounds—an increase of nearly twenty times. Cotton planted after an inoculated crop of red clover gave an increased yield of 40 per cent. Potatoes, after an inoculated crop yielded an increase of 50 per cent. The wheat crop increased by 46 per cent., the oats 300 per cent., and the rye 400 per cent. It must be clearly understood, however, that only leguminous plants—beans, clover, alfalfa, peas, lupin, vetch, etc.—are directly benefited by the nitrogen-fixing bacteria."

Here is a discovery which should prove salvation to India. We have millions and millions of acres of land which are barren and produce nothing. By means of this powder, food for millions may be produced in these lands and starvation driven from the country.

INOCULATION OF LEGUMES AND THE AMERICAN DEPARTMENT OF AGRICULTURE

A bulletin on "Soil Inoculation for Legumes" has been issued by the American Department of Agriculture, setting forth the results of elaborate investigations in the subject made by Dr. George, T. Moore, Director of the Bureau of Plant Industry. The introduction of "Nitrogen" in Germany a few years ago gave rise to hopes which were not realised, and Dr. Moore set to work to ascertain the cause of failure, and to remedy it, if possible. The character of the root-nodule organisms which fix atmospheric nitrogen was patiently studied, and it was found to be a true micro-organism, existing in three well-defined stages. These nodule forming bacteria have the property of "fixing" nitrogen in the soil in contact with the root of the leguminous plant, and of thus, in effect,

manuring the root. The actual chemical and biological processes are a matter of some theoretic dispute, though it seems probable that the bacteria are animated by no benevolent intention, but pierce the root of the plant in search of carbo-hydrates, while the plant retaliates on them by absorbing them and the nitrogenous food they bring. What is more important to the agriculturist is a knowledge of the best way of applying these preparations of bacteria to the plant and to the soil. Instead of a different organism being required for each kind of leguminous plant, as assumed by German investigators, Dr. Moore's experiments led to the conclusion that there is only one species named Preudomonas radicicola. The difference in the inoculative power of organisms from different legumes is attributed to slight physiological variations, which can be broken down easily by cultivation.

"Nitragin", as the bacterial preparation is commercially called, in the earlier stages of its preparation and application was found by the Germans to produce results good, bad, and indifferent. The preparation was expensive, and sometimes difficult of application. The United States Laboratory of Plant Physiology has now found a thoroughly practical and satisfactory method of plant inoculation, and it is distributing 'cultures' of the nitrogenous bacteria to farmers all over the United States. They have found that these bacteria can support a good deal of drying. They therefore saturate absorbent cotton in a liquid culture of the bacterial organism. In this way millions of bacteria are held within the cotton, and after this is carefully dried out they remain dormant in it. They are thus distributed to farmers, and the bacteria can be revived by putting the cotton in water before placing it in contact with the seeds that are to be sown. The water used for reviving the bacteria also has some preparation so that it will better support the bacteria than other organisms. For this purpose the department distributes small packets of nutrient salts with the cotton culture.

During the two years ended in November last about 12,500 packages of it were distributed among farmers by the Department of Agriculture. From these men 2,502 reports have been received, and more than half state that a definite increase has resulted, while most of the rest attribute lack of success to the presence of the necessary organisms in their soil or to bad seasons, poor seed, weeds, or some other disadvantage.

DR. MOORE'S PATENT

An esteemed correspondent writes:—As a good deal of interest had been aroused by the description of the newer methods evolved in America for the application of Nitrogen-fixing organism as manures in the "Century Magazine" and elsewhere, I venture to think the enclosed copy of the United States Patent which the discoverer has taken out may be interesting to your readers. I send it along in case you think it might be worth publication:—

UNITED STATE PATENT OFFICE.

George T. Moore, of Washington, District of Columbia.

Process of preparing for distribution organisms which fix atmospheric Nitrogen.

Specification forming part of letters patent No. 755, 519, dated March 22, 1904. Application filed May 4, 1903. Serial No. 155,695 (No specimens).

To all whom it may concern:—Be it known that I, George T. Moore, a citizen of the United States, residing at Washington, in the District of Columbia, have invented new and useful improvements in the process of preparing for distribution organisms which fix or gather atmospheric Nitrogen, of which the following is a specification:—

This application is made under the Act of March 3, 1883, Chapter 143, and the invention herein described and claimed, if patented, may be used by the Government of the United States or any of its officers, or employees in prosecution of work for the Government or by any other person in the United States without the payment to me of any royalty thereon.

The invention relates to the process of growing these organisms and preparing them for distribution.

The invention has for its object the production of more highly effective organisms and their distribution in a form preventing deterioration and easily applied in agriculture. All work that has heretofore been done in the cultivation of nitrogen-gathering roof-tubercle organisms for use in agriculture has been done in culture media containing either decoctions of the leguminous plants, from which these specific organisms in each case were obtained, or in media containing some other available form of combined nitrogen not free or atmospheric. When there is available combined nitrogen in the medium, the organisms instead of depending solely upon the atmospheric nitrogen for their nitrogen-supply draw upon the nitrogenous materials of the culture medium—such, for example as proteids,

nitrates, ammonium compounds, etc.—for which reason they do not develop their full nitrogen-gathering power and rapidly deteriorate.

By my process the organisms are first obtained from the tubercles or swellings on the roots of the leguminous plants—such as clovers, cow-peas, beans, &c. After the tubercles are thoroughly washed and surface sterilized in the ordinary ways the interior of the tubercle is cut out under sterile conditions and mixed in a medium consisting of water containing about one per cent. commercial agar-agar, about one per cent. maltose sugar or cane-sugar, (the former being the better), about ·02 to ·05 per cent. magnesium sulphate, and about 0·1 per cent. monobasic potassium phosphate. This solution is made up in the ordinary way and sterilizing according to ordinary bacteriological processes. It differs from ordinary culture media for bacteria only in the absence of a source of combined nitrogen. The agar may be varied above or below the amount suggested. The maltose or cane-sugar may be increased to ten per cent., the magnesium sulphate to one per cent., the monobasic potassium to two per cent., or the amounts may be lowered below the quantities first mentioned. In the latter case, however, the food materials are more quickly used up. The organism multiplies as long as the materials in solution are not exhausted. Other compounds may be used as sources of magnesium, potassium, and phosphoric acid. Although I usually leave nitrogen out of the culture medium at this stage, its absence is not essential, as the object of the first step is simply to separate the organisms into pure cultures free from mold or other contamination, the process of separating out in this fashion being familiar to all bacteriologists and in common use. They grow best between 20 and 30 centigrade and light or its absence is immaterial. When pure cultures are thus obtained, the organism is transferred immediately, or after several weeks, if desired, by any of the bacteriological transfer methods in use to water containing about one per cent. cane-sugar or maltose, (the latter being the better,) about ·02 to ·05 per cent. magnesium sulphate, and about 0·1 per cent. monobasic potassium phosphate, or equivalent sources of magnesium, potassium, and phosphorus, as in the case of the first-described medium. The quantities used may here also vary, as stated above; but the per cents. given have been found to be the most favourable for growth under ordinary conditions. One cubic centi-

meter of the culture will suffice for impregnating one hundred liters of the fluid. Any kind of container or vessel that can be easily cleaned will serve for this purpose; but Erlenmeyer flasks are best where small quantities are to be cultivated under antiseptic conditions. In this solution, which should be kept between 20 deg. and 30 deg. centigradem in light or darkness, as desired, the organisms increase very rapidly and have to obtain all of their nitrogen in the free state from the atmosphere or from the atmospheric nitrogen in solution in the medium. This liquid culture solution, even when in large quantity, will in a few days become milky in appearanee by the presence of immense numbers of the developing organisms. The water containing the organisms, where direct use is desired, is then sprinkled upon seeds or soil; but for the purposes of preservation and distribution the following steps are taken: Absorbent cotton or other equivalent material is dipped into the water containing the organisms or the water containing the organisms is sprinkled upon the cotton or other material and the same thoroughly air-dried in a chamber free from dust or contamination by molds. The drying is facilitated by forcing a current of air through the chamber by aspiration through sulphuric acid, potassium hydroxid, calcium hydroxid, sodium hydroxid, or any of the other ordinary materials used in laboratories for drying. In this dry form the organisms may be kept indefinitely without deterioration or change and may be safely, easily, and cheaply transported to any distance, either through the mails or otherwise. In using the organisms preserved as above described the dry absorbent material containing them is simply dropped into a water solution of the same composition as above described. Where the purpose is to treat soil or seed, it is necessary to observe strictly anticeptic precautions. Ordinary clean vessels or tubes may be used, simply protected from dust and ordinary well-water or rain-water is used in making the culture solution, as the amount of nitrates or ammonia which such waters ordinarily contain does not interfere with the vitality of the organisms at this stage of the process. The temperature and light conditions should be as previously stated. In from twelve to forty-eight hours the organisms will have increased in the water culture as in the first instance. At this stage in order to stimulate a very rapid division of the bacteria about one per cent. phosphate of ammonia is added to the culture solution. The quantity of liquid culture that may

be thus obtained is limited only by the amount of water used containing the sugar, magnesium sulphate, and potassium phosphate or other equivalent sources of magnesium potassium, and phosphorus, as above described. After thus obtaining the liquid culture it is then necessary only to sprinkle the seeds or soil to be treated with water containing the organisms and then dry them in the ordinary way to facilitate planting. The propagation of the bacteria should not be continued longer than twelve to forty-eight hours after the addition of the phosphate of ammonia; otherwise they will deteriorate in nitrogen-fixing power, as previously explained, and organisms thus stimulated should be used only for seed or soil impregnation and for preservation or distribution.

Having thus described my invention, what I claim, and desire to secure by Letters Patent, is :—

The process of preparing for distribution nitrogen-gathering organisms, which consists in moistening suitable absorbent material with a solution in which such organisms are suspended, and afterwards thoroughly drying the material substantially as hereinbefore described.

In testimony whereof I have signed my name, to this specification in the presence of two subscribing witnesses.

Witnesses : GEORGE T. MOORE.
A. F. Woods.
Geo. P. HcCabe.

LATEST PROCESS OF EXTRACTING NITROGEN FROM THE ATMOSPHERE BY ELECTRIC POWER

INVENTION OF NORWEGIAN ENGINEERS

Some twelve or eighteen months ago the insufficiency of nitrogen in Ceylon soils was much emphasised, and as nitrogen is an essential constituent of plant food the possibility of securing it from the atmosphere was much discussed. Crotalaria, Groundnuts, Dadaps, and Albizzias were on every planter's lips. They are still in many planter's tea-fields! and it is said, claim from many a busy V. A. "the passing tribute of a sigh." Be this as it may, the fact remains that cultivators in Ceylon have still to buy the manure their crops need and one of the greatest problems, as far as the agriculturist is concerned—the discovery of some cheaper form of nitrogenous manure—still remains unsolved. The nitrogen exists in abundance—in the air. A column of air resting upon one square mile of land it is calculated contains

sufficient nitrogen to supply all the farmers in the world for 50 or a 100 years. It is a process of extraction sufficiently economical to permit the product to be sold at a reasonable price, that is now wanted. At last we seem to be in sight of a solution. Two Norwegian engineers, it is reported, after several years of experiment, have evolved a particular type of electric flame which effectively combines the oxygen and nitrogen in the atmosphere so as to produce nitric acid, and certain salts of nitrogen. They began work on a small scale in June 1903, with a twenty-horse-power engine, but they succeeded so rapidly that within a few months they moved to another site, where they were able to obtain electric current up to a thousand horse-power. After another move they established themselves last May in the neighbourhood of Notodden, in close proximity to a waterfall, which will yield when fully employed as much as 30,000 horse-power. At present they have three electrical furnaces at work, each employing seven hundred horse-power. The nitric acid obtained from the air is passed into stone towers capable of holding forty cubic metres, or the rough equivalent of forty tons. While the chemical re-action is going on, various gases are given off and these are subsequently treated with lime, thus securing deposits of calcium nitrite and calcium nitrate. The former product is the one which is of most value for agricultural purposes, being equivalent to the natural nitrates exported from Chili. Nitric acid itself is, of course, valuable for the manufacture of any other nitrates for which there may be a commercial demand. The calcium nitrate is largely used in dyeing. Without going into details, however, the important point is that these two Norwegian engineers have now shown that it is practically possible to lay hold of the nitrogen in the air to apply it to agricultural and industrial purposes. They have also shown that the process is commercially profitable, and they are finding no difficulty in obtaining the necessary capital to extend their business. An immense field of future industrial activity is thus opened up, especially in countries where water-power is available.

AN INDIA-GOVERNMENT CIRCULAR.

Simla, April 27,1905

A correspondence has been published for starting experiments in the inoculation of soil with nitrogen fixing bacteria in the various provinces. The circular-letter which has been issued by

Mr. Sly, Inspector General of Agriculture, runs as follows:—

"I have the honour to make the following suggestions for the starting of experiments in the inoculation of the soil with nitrogen-fixing bacteria.

(2) It is perhaps advisable in the first place to correct some popular errors in regard to the possibilities of soil inoculation. The method can only be applied to leguminous crop and the advantage, if any, to crops of cereals and vegetables, is derived from the available nitrogen accumulated in the soil by such preceeding leguminous crop. The best result in America has been obtained by inoculating each kind of legume with a culture obtained from its new nodules. Several persons have obtained from America cultures for clover and other crops that are unknown in the plains of India, which are useless for trial in this country. It must be also remembered that the bacteria are very susceptible of a change in their environment, so that it is impossible that cultures prepared in America will be suited to the very different climatic conditions of India.

(3) I beg to enclose a copy of the patent describing the method of preparation of cultures and to suggest the experiments should be started to isolate and cultivate the nitrogen-fixing bacteria of one or two of the principal leguminous crop of the province at any available laboratory. Pot-culture trials could then be made to test the result in soil (*a*) in which the same crop has often been grown and (*b*) in which crop has never been grown. In selecting the soils it should be remembered that inoculation would be of little benefit in any rich soil containing a large amount of available nitrogen. If these trials give promise of success experiments on a larger scale can then be started. Full information about the system is given in *Bulletin No. 71, United States Department of Agriculture, Washington.*

(4) Even when all the preliminary difficulties are overcome, the limitations of the method must be recognised. The only purpose of soil inoculation is to furnish nitrogen to the plants in an available form, and it is evident that little benefit can be expected from inoculation of a soil in which organisms are already abundant. The remarkable results in America have been obtained by the artificial introduction of the necessary organisms into the soil, naturally devoid of them in which leguminous crops have not been previously grown. The growth of a leguminous crop in rotation for the purpose of soil renovation is already so widely practised in India that there does

not seem much scope for artificial inoculation."

GOVERNMENT EXPERIMENTS IN INDIA

The new method of fertilising land by inoculation with nitrogen-collecting bacteria as discovered by Dr. Moore, of the United States, is being tested at Kunigal in the Mysore State in connection with the Government Stud Farm for horse-breeding. The imported lucerne seed (Egyptian Alfalfa) which was obtained by the farm on Lord Kitchener's recommendation, gave a fair crop on first cutting, but failed to recover as quickly and to give equal crops with the local lucerne grown under similar conditions.

AN OFFICIAL REPORT OF THE BUREAU OF PLANT INDUSTRY, U. S. A.

Experiments are now being conducted in some parts of India with nitro-cultures. It may therefore be of some interest to those so engaged to know what the United States Department of Agriculture is doing in this connection. The following report by Karl F. Kellermaun, Physiologist in charge of the Laboratory of Plant Physiology, and F. R. Robinson, Assistant in Physiology, Vegetable Pathalogical and Physiological Investigations, Bureau of Plant Industry, U. S. A., is worthy of careful study.

Introduction

The method of distributing practically pure cultures of nitrogen-fixing bacteria dried on cotton has not proved entirely satisfactory, owing to varying conditions of air, during transit in the mails and to certain matters connected with laboratory technique. While the number of unsuccessful attempts to secure inoculation by users of cotton-cultures sent out by the Department of Agriculture is small, it has been recognized that the methods of preparing the organisms and distributing them were open to improvements. Investigations have been under way for some time with a view to improving the methods followed, and as a result the Department is now prepared to send out bacteriologically pure cultures in small tubes hermetically sealed.

The experiments carried on by the Department of Agriculture have demonstrated the fact that by the proper use of practically pure cultures, the nodule-forming bacteria are actually carried into the soil. These bacteria are able to form root nodules, and where other conditions are favourable, the inoculation thus brought about

makes possible the growth of a legume in soils where it had failed previously from lack of bacteria. The original cultures used, however, must be prepared with the utmost care and with a view to preserving or increasing their natural power of nitrogen fixation rather than merely to make them grow under favourable conditions.

DIRECTIONS FOR USING CULTURES

The following directions will accompany the packages distributed under this new plan:

I. To prepare the Culture-Liquid:—Put one gallon of clean water (preferably luke-warm rain water) in a clean bucket or jar and add 3 heaping tea-spoonfuls of granulated or brown sugar; then add the tablet contained in the small envelope No. 1. Allow all to dissolve, stirring with a clean rod or spoon, if necessary.

Carefully open package No. 2, breaking off the top of the glass tube, being careful not to spill the liquid, and pour the contents into the solution. Cover the bucket with a paper or moist cloth to protect from dust, and set aside in a warm place for twenty-four hours. About 70 degree F. is the best temperature. Do not heat the solution or you will kill the bacteria; it should never be as warm as blood-heat.

After twenty-four hours add the tablet in envelope No. 3 and allow the mixture to stand another twenty-four hours. The liquid should now be faintly cloudy and ready for use. If sufficient growth has not taken place to bring about this cloudiness, further time should be given, not to exceed two days.

II. To Inoculate Seed:—Take just enough of the solution to moisten the seed (1 gallon will moisten 2 bushels of seed). Stir thoroughly, so that all the seeds will be touched by the solution. Spread out the seeds in a shady place, rake over occasionally until dry, and plant just as you would untreated seed. If bad weather should prevent planting at once, the inoculated seed, thoroughly dried and properly stored, may usually be kept without deterioration for several weeks.

III. To Inoculate Soil:—Take enough dry soil so that the solution will merely moisten it. Mix thoroughly, to moisten every particle, and mix this with four or five times as much—say half a wagon-load. Spread this inoculated soil thinly and evenly over the prepared ground exactly as if spreading fertilizer. The inoculated soil should be harrowed in immediately.

Either of the above methods may be used as convenient.

Information for Users of Inoculating Material

The inclosed package, marked "No. 2," contains a pure liquid culture of bacteria. This culture treated according to directions will produce a liquid-culture which, if associated with the proper plants, is capable of rendering available to these plants the free nitrogen of the air. This is accomplished through the formation of root nodules.

The bacteria are capable of making up for a deficiency of soil nitrogen, but where other elements, such as potash and phosphoric acid, are lacking, inoculation will not do away with the necessity for fertilizers containing these substances. Mineral fertilizers, however, should never be applied so as to come into direct contact with inoculated seed. The action of concentrated fertilizers drilled with inoculated seeds is injurious; this is especially true if the seeds should be still moist after treating with liquid culture. Floors used for drying inoculated seeds should be thoroughly scrubbed and rinsed, especially if the same floor space has served for mixing fertilizers. The liquid on the seeds is able to dissolve chemicals contained in the fertilizers, and the effect might be disastrous alike to seeds and bacteria. Moistened seeds should *never be dried by mixing with* pulverized fertilizers; if it seems desirable to hasten drying, clean sand or dirt is the best material to use. Fertilizers should be spread and mixed with the soil or drilled previous to sowing the seed, and if the drill has been used for this purpose, all parts with which the seeds may come in contact should be cleaned.

This material is furnished you with the understanding that you will carefully follow instructions in its use and will report your success or failure to secure good inoculation. Note the presence or absence of nodules on the roots of inoculated and uninoculated plants.

When Inoculation is Desirable

(1) If a soil is low in organic matter and has not previously borne leguminous crops.

(2) If legumes previously grown on the same land were devoid of nodules.

(3) If the legume to be sown belongs to a species not closely related to one previously grown on the same soil.

When Inoculation may Prove Advantageous

(1) If the soil produces a sickly growth of legumes, even though their roots show some nodules.

(2) If a leguminous crop has made a stand but gives evidence

of failure, due to the absence of root nodules. Under such conditions it is advisable to apply the culture-liquid by spraying or, better, by top-dressing the land with soil moistened with the culture liquid, as explained in the directions.

When Inoculation is Useless

(1) If the legumes usually grown are producing average yields or the roots show nodules in abundance.

(2) If the soil is rich in nitrogen it is neither necessary nor profitable to inoculate a soil rich in nitrogen; few nodules are formed under these conditions.

Cultures of nitrogen-fixing bacteria are not to be regarded in the light of nitrogenous fertilizers, increasing yields under all average conditions. The bacteria do not contain nitrogen. If conditions are favourable, they render nitrogen obtained from the air available for the legume.

When Inoculation will be Failure

(1) If the directions are not studied intelligently and followed carefully.

(2) If the soil is acid and is in need of lime. Liming to correct acidity is as important for the proper activity of the bacteria as for the growth of the plants.

(3) If the soil needs fertilizers, such as potash, phosphoric-acid, or lime. The activity of the bacteria in securing nitrogen from the air and rendering it available to the legumes will not take the place of such fertilizing elements as potash and phosphorous.

It must be remembered that inoculation will not overcome results due to bad seed, improper preparation and cultivation of ground, and decidedly adverse conditions of weather or climate. Before attempting to inoculate a new crop, the farmer should first inform himself thoroughly concerning the proper handling of the crop itself; otherwise failure is almost certain. As an illustration, sowing alfalfa on hastily prepared land, on land foul with weeds, on acid soils, or soils underlaid with hard pan is contrary to accepted practice. Free publications covering the essential points in growing all common legumes may be obtained from the State experiment stations and from the United States Department of Agriculture.

Keeping Cultures for Future Use

The possibility of farmers keeping cultures from one year to another has been suggested. This practice is not to be advised in any case. For good results, it is necessary to start with a fresh,

pure culture. The pure culture, moreover, can be prepared only by a trained bacteriologist with laboratory facilities.

Confusion of Nematode Galls with Nodules

Nematode galls, or root-knots, are often mistaken for nodules, which they resemble in appearance. The nematode gall is extremely injurious, and in regions where it has been known to exist, it is unwise to plant crops favourable to the development of the pest. Nearly all of the legumes should be avoided. This is important not only because the legumes susceptible to nematode attack are themselves injured, but chiefly because they furnish conditions favourable to the rapid development and multiplication of the nematode worms, and these may become a serious menace to succeeding crops or to orchard stock which, under ordinary conditions, they would scarcely injure. There are, however, some resistant varieties upon which the nematode worm can not develop and in infested regions these resistant, varieties should be used exclusively. If a leguminous crop with its roots covered with what are apparently nodules makes a sickly growth, or if there is doubt as to whether a legume is inoculed at or infested with nematodes, samples for examination should be forwarded to the Department of Agriculture.

A NEW MANURE: Dr. A. D. HALL'S DISCOVERY

Dr. A.D. Hall, Superintendent of the Rothamsted Experimental Farm, has given in the "Field" the results of a trial of Calcium-Cynamide, a new manure made in Berlin by heating calcium-carbide in a current of nitrogen from the air. This manure contains about 20 per cent of nitrogen, or nearly as much as sulphate of ammonia, and, when tried against a slightly less weight of that manure for mangolds, swedes, and mustard, it gave slightly more of the first, nearly $2\frac{1}{2}$ tons less of the second, and a trifle less of the third. The dryness of the season was against the new manure, which requires even more moisture than sulphate of ammonia to make it act fully. The manure arrived at Rothamsted too late to be tried on corn last season. Dr. Hall thinks it can be put on the market at about £10 per ton, at which price, he adds, it would be an advantageous manure. But it is to be hoped that improvement in the process of manufacture will allow of much cheaper production.

THE NEW AGRICULTURE

CROPS BY ELECTRICITY

"The open fields" is to become a phrase of the past. The fields of the future will be covered in with a net-work of wires which will radiate high-tension electricity through the crops beneath, and bring them to a fruitfulness such as the old-fashioned sunshine could not possibly bestow.

Such, at any rate, is the potentialoutcome of experiments, writes a "Tribune" correspondent from Evesham, under date March 27th, which Mr. J. E. Newman, an electrical engineer, is carrying out on a farm at Iron Cross, midway between this town and Alcester. Twenty acres of arable land belonging to Messrs. R. and B. Bomfort are traversed sixteen feet above the ground by wires suspended from poles placed at intervals of a hundred yards. The wires are insulated so completely that the current can find its way to the ground only through the air, and consequently through the crops. Unfortunately, there is on the farm no streamlet capable of generating an electric current, and a 3-horse power oil engine is therefore used for the purpose; it drives a dynamo, the current from which is converted to a high tension before transmission to the wires. The engine is run for only a few hours a day at intervals varying in length according to the state of the weather and the amount of moisture in the soil. When the ground is very dry the current appears to be harmful rather then beneficial, particularly in the case of peas, beans and clover, when they have once appeared above the surface.

Hopes of 25 Per Cent. Increase

Twelve of the acres included in the experiment have been sown with wheat, seven with barley, and there are small plots of other crops. In the case of almost all of them Mr. Newman confidently expects that germination will be hastened and the yield increased as a results of the discharge of electricity from the wires. In the case of the wheat, he says, he will be disappointed if the yield, both of grain and of straw, be not twenty-five per cent. greater than it would be otherwise, and if there be not also such an improvement in the character of the grain as will make it equal, for milling purposes, to Canadian wheat.

These anticipations are to some extent based on the results of experiments as to the effects of electricity on vegetable growth which were carried out by the late Professor Lemstrom, of Helsingfors

University, in Germany, and at Durham, and also of previous experiments made by Mr. Newman himself.

Jointly with the experiments in Worcestershire, Mr. Newman is prosecuting researches at Bitton, near Bristol. Last year he obtained very encouraging results from the distribution of current over tomatoes and cucumbers grown indoors, and cabbages, peas, beans, and strawberries grown outside. Especially marked was the enhanced rapidity with which peas under the influence of the current appeared above ground as compared with those not so stimulated.

In all previous experiments of this kind, however, low tension electricity has been employed, and it is believed that the present trials at Iron Cross are the first in which a high-tension current derived from a dynamo has been made use of in this way. In the unsuccessful experiments made in Russia some years ago, the current was discharged direct into the soil.

Telegraphs in a Tangle

The poles and wires at Iron Cross have been fixed at such a height as to permit of steam ploughing and they give the fields an extraordinary appearance. People stare in amazement at what seems to be a telegraph system in a tangle. If the nearest rustic be interrogated, the reply given with a knowing smile is —"Farmer Bomford thinks he can grow wheat by electricity," and the experiment is regarded locally as a great joke.

That fact however, by no means disturbs the equanimity of Mr. Newman. It is, indeed, quite within the bounds of possibility, given an adequate supply of electricity at a sufficiently cheap rate, that in the not very distant future Great Britain may once more be able to produce the bulk of the wheat she consumes, and to find employment for a much greater proportion of her sons upon her own soil.

MANURES : SEA-WEED — A VALUABLE FERTILISER

A Ceylon correspondent points out that a valuable fertiliser is now available to suburban residents. Immense quantities of sea-weed are being cast ashore by the waves between Kollupitiya and Dehiwala on the sea-coast line of railway. As the plants make an excellent and rich fertiliser in the flower and fruit gardens, it is a pity to see all this run to waste. Truck-loads of the weeds are procurable.

BONE-MEAL

Bone contains ingredients, such s lime, carbon and phosphate, tc., which are very useful to the rowth of plants. When crushed nto powder, it forms a powerful nd handy fertiliser and, of recent ears, it is being largely used by armers to enrich the soil over which it is evenly spread in small quantities. Taking advantage of the fact that enormous amount of bone, easily available for man- uring purposes at a comparatively small cost, is being annually wasted, several Bone Crushing Mills have been started in India to utilise the same. The following is a list of the principal Mills from whom Bone-Meal can be had:—

1. Agricultural Phosphate Co. Ltd., 7, Church Lane, Calcutta.
2. Arbuthnot & Co., Malabar, Madras.
3. Bally Khal B[illegible] Mills, Bally, E. I. R., 28, Dalhousie Square, Calcutta.
4. Belur Works, South Canara, Madras.
5. Bengal Bone Mill Co., 15, [illegible] Street, Calcutta.
6. Bone Mill of Croft Mody & Co., Thana; 10 B[illegible]k Street, Bombay.
7. Cassim Mahomed's Bone Factory, M[illegible], Island of Bombay
8. Chingrihatta Bone Mills, Chingrihatta, 24, Parganas, 19, Muktaram Babu's Street, Calcutta.
9. Coen's Bone Crushing Factory, W. Whelan Coen & Co., Dharwar.
10. Currimbhoy Manji's Mills, Mazagon, Island of Bombay.
11. Ganges Valley Bone Mill Co., Ltd., Graham & Co, Agents, 9, Clive Street, Calcutta
12. Indus Valley Bone Mill Co., Ltd., Karachi, Sind
13. Kalai Bone Works, Calicut, Madras.
14. Lion Bone-Meal Works, Bangalore, Madras.
15. Manure Works of T. Stanes & Co., Coimbatore, Madras.
16. Mc.Ilinch Bone Crushing Mill, Karachi, Sind.
17. Mackenzie's Bone Mills, Island of Bombay.
18. Mokamah Bone Mills, Mokamah, E.I.R.
19. Moracoon Bone Crushing and Coffee Curing Works, Tellicherry, Madras.
20. Pierce Leslie & Co, Coimbatore, Madras.
21. Ratanji and Mulsett's Mills, Island of Bombay.
22. Ripon Bone Mills, Island of Bombay.
23. Shapunji Nanabhoy Mills, Mazagon, Island of Bombay.

P. R. C.

RICE-HUSK-ASH AS MANURE

An interesting economic dis- covery of the Government Econo- mic Products Department is that the charred rice husks from the rice mills in Burma are worth using as a dressing to land. A demand will probably now spring up for this bye-product of the Burma mills which has hitherto been left unutilized.

The utility of rice-husk-ash as a manure is reported upon in Commercial Circular No. 2. of 1904 by Mr. D. Hooper, the Reporter on Economic Products

to the Government of India. This waste-product has been much neglected, and in and about Rangoon it has been principally utilised to raise low-lying land. A chemical analysis proves it to be a manure which would be of service to the soil of Burma. The fertilising constituents are not very largely represented in the analysis, but comparing the composition with that of rice soils of Burma, published by Dr. R. Romanis, the return of the ash to the land would be a distinct improvement, as these soils contain on an average ·08 per cent. of lime, 15 per cent. of potash, and 11 per cent. of phosphoric acid. The silicious ash might also be employed in manufacturing mortars and cements by mixing it with lime in suitable proportions. A further use suggests itself as a polishing material, since it is known that silicious substances, like the horse-tail and the leaves of certain fig trees, are used for such purposes in many parts of the world.

GREEN MANURES IN CEYLON

While the value of green manure has been generally recognised by the Ceylon planter only recently, it is interesting to note that it has been systematically carried on by Cinhalese villagers for hundreds of years, and the practice is still in vogue. Mr. Wright has recommended, the well-known Cantalaria Striata dadaps and ground-nuts as valuable green manures. The native villager uses with excellent results as green manure wild plants totally different to those mentioned and secures them without difficulty.

NEEM LEAVES AS MANURE

The Madras Agricultural Department has been engaged in the interesting experiment of testing the qualities of Neem leaves as manure. In some parts of the south, for long have Neem leaves been used as manure with excellent results. The experiment may be made in other Provinces and the result of the Madras experiment should be taken advantage of.

FRESH STABLE REFUSE AS MANURE: ITS UNIQUE ACTION ON A MODEL FARM

Mr. W. J. Spillman, Agrostologist, Bureau of Plant Industry of the Department of Agriculture, U.S., America, relates, in a pam-

phlet named "A Model Farm", the account of some very striking results attained in a small farm of only 35 acres by the special handling of stable manures. "It has been brought up to its present remarkable state of fertility," says Mr. Spillman, "solely by the use of stable manure applied directly from the barn, as it was produced. The system of handling manure is such that none is lost, either liquid or solid. No commercial fertilizers have ever been used, and no manure has been hauled from the city.

"The remarkable yields on this farm are due to the intelligent use of stable manure. Most farmers waste more than half the value of the manure produced on their farms. It is estimated that five-eighths of the plant food in the manure of farm animals is contained in the liquids. On this farm every particle of this plant food is utilized.

"The method of handling manure on this farm can be used only on farms on which stock is kept in stalls.

"Behind each row of cows is a gutter 18 inches wide and 7 inches deep. These gutters have no outlets. They are thoroughly cleared daily. Each gutter ends near a door. The manure is lifted from the gutter into a cart backed up to the door. The end of the gutter next the door is slightly lower than the other end. The liquid manure is all gotten into the cart which goes immediately to the field and the manure is spread at once.

"The fact that it is applied daily as produced, insures that any leaching by rains shall carry the leached materials into the soil where it is wanted. How much plant food is lost from fermentation after the manure is spread on the fields is not known. But the remarkable yields of every portion of this farm would seem to indicate that this method of handling manure is highly satisfactory."

CAMPHOR IN GERMINATION OF SEEDS

An important use of camphor, and one not generally known, is as an aid to the germination of seeds and the growth of cuttings. It is said that most seeds are greatly hastened in their germination by being soaked previous to sowing in a pint of soft water into which a lump of camphor, about the size of a large nut, has been added. According to a writer in the "Journal of Agriculture," this experiment has been found very successful with many varieties of vegetable seeds, such as peas, beans, etc., as well as palms, castor-oil and various other

tropical seeds, which have very hard shells, many of which would require soaking in water for a long time before they would otherwise show signs of germination. These, however, with the addition of camphor are said to sprout easily and rapidly. According to the same authority camphor can be equally well employed in stimulating cuttings of roses or other plants sent from one country to another. Rose cuttings, for example, "posted in England, can be carried safely to India, and the stimulation caused by dipping their freshly cut ends in camphor water helps greatly to enable them to take root when placed in the soil."

COPPER-SULPHATE AS FUNGICIDE

Extensive demonstrations have lately been conducted in Berar to teach the cultivators the advantages of immunising *juar* against disease by pickling the seed in sulphate of copper. As a fungicide for this particular crop no more effective agent than sulphate of copper has yet been discovered, and it is reported that the cultivators have been so far impressed by the success already obtained that in many districts of Berar they have keenly taken up the experiment.

AN INSECTICIDE

Mr. W. E. Everette, of Tacoma, Washington, has secured a patent for an insecticide, which he claims will destroy insects, caterpillars, worms, and their eggs, fungus-growth, and other hurtful pests which attack trees and plants. To make this insecticide take one pound of each of the following ingredients sulphur, resin of pine, soap-powder, sodium oxide, tobacco-stems, castor-oil beans, and pyretherum-flowers, and add about one pound of asphalt-petroleum, about one pound of fuming sulphuric acid, and about one pound of commercial phenic-alcohol (carbolic acid). By asphalt petroleum is meant that class of petroleum which has an asphalt base in distinction from that which has a paraffin base or residue. These ingredients are to be mixed to the condition of a dough-like mass or paste and preferably divided into small portions—say about one ounce packages. To preserve these packages from the air, they are preferably wrapped in paraffin-paper and tin-foil. In using this compound one ounce is to be diluted with about a gallon of boiling water and then sprayed upon the tree or fine. (Patent No. 796,603.)

INROADS OF LOCUSTS

Success of Simple Remedies

When a specimen of the insect shows that it contains immature eggs on examination by the entomologist, the warning ought to be the reason for a more wholesale campaign against the threatened new generation and speedier measures ought to be taken for the destruction of the young locust as soon as they appear. In the Panjab, where the pest does apalling damage to the crop, the cultivating classes employ some extremely simple remedies for its extermination which not unfrequently turn out to be more effective and successful than many of the more elaborate devices. Among the methods found to be most efficacious, we quote the following as being very interesting and inexpensive :—

1. The somewhat primitive plan of dragging a bag shaped like a pillow-case close at each end and open on the long side is employed in Berar. The bag is held by two men, one at each end, across the width of the field in such a way as to gather the young hoppers without in any way injuring the crops.

2. A still more simple remedy is to beat the crops with branches. In this way, a very large number of locusts were destroyed.

3. When crops are too high for the employment of the above remedies, empty Kerosine oil cases are placed in a particular position and the locusts driven into it.

4. The most effective agent of keeping down the pest in Berar is reported to be the *Juari* bird which devour enormous number of locusts.

It has been asserted and is believed that prevailing direction of the wind at different seasons of the year is the determining cause of the arrival and departure of locust swarms.

P. R. C.

HINTS ON COCOANUT GROWING

Cocoanut-tree growers would be interested to read the following advice published by a Madras contemporary contributed by one of its correspondents :—Cut off some of the lower branches to admit light and air among the trees. Dig square pits to the depth of a yard round each tree and cut off the side roots. Then fill up the pits with prickly pear, cover it with earth or manure and water the trees incessantly. You will have a good yield soon. This practice is adopted with success by the owner of a cocoanut tope in Tawker's Choultry.

Another advice is to remove some of the cocoanut trees in the rainy season and to plant them elsewhere, as the trees require free light and air among them. I know of many cases where cocoanut trees 15 or 20 ft. high have been so removed and planted, with the result that the newly transplanted trees have given a good yield.

NECESSARY AIDS TO AGRICULTURE

Mr. Dwijadas Datta, Cirencester scholar, England, in submitting the Annual Report of the Shibpur Experimental Farm for the year 1902-03 observes:—"To sum up, I may suggest that measures necessary to aid Indian agriculture are (1) the means for improving the supply of food for cattle and especially by means of edible shrubs in time of drought; (2) the formation of fuel and timber reserves whenever land is available for the purpose in order to save the burning of manure and mitigate the climate; (3) the conservation and improvement of headwater and the arrestment of water flowing into tanks, and improvements of tanks and streams by planting their margins; (4) the supply of a sufficient number of central experimental stations; (5) the formation of experimental gardens to be attached to the schools and managed and worked by the masters and scholars, a beginning as regards which has already been made in the Central Provinces; and (6) measures for the suppression of insect pests, and more especially locusts, which now exist to an alarming extent in certain parts of India, and it is here that the schools may be made of great value."

UTILISATION OF VEGETABLE PRODUCTS

Australia offers a vast and practically inexhaustible field for those experienced in the industrial utilisation of vegetable products. Although the practical value of economical botany remains imperfectly understood throughout the Commonwealth, there are not wanting indications of its approaching recognition as a new and valuable source of national wealth. Some few months ago, Mr. R. T. Baker, F.L.S., curator and economical botanist of the Sydney Technological Museum, appeared as a witness before a Royal Commission appointed to enquire into the condition of the western lands of New South Wales. In the course of his examination, he produced samples of

eucalyptus oil in various stages, extracted from trees in the eastern portions of State, remarking that they were of the highest quality, fully equal to the best in the market. A vast amount of research had lately been made in connection with the Australian flora, with very valuable results. For instance, myrticolorin, a new dyeing material, had been obtained from the leaves of the red stringly bark, in addition to the valuable oil extracted from the same source. This dye, which was not yet on the market, gave a lighter and better colour than the American quercitrin, obtained from the bark of an American oak, and consequently might be regarded as a dye-product, likely to prove of commercial importance. A quantity of the dye had been sent home to the leading manufacturers in England and Germany. The manufacturers in England were delighted with the results, and sent back several specimens of cloth, showing the beauty and utility of the dye.

Out of trees and shrubs in the eastern portion of the State, Mr. Baker had, with the assistance of his staff, extracted camphor, perfumes (such as otto of roses, ionone, and cinnamon), dyes, and peppermint, and cajuput-oils which ought now to be pushed on the market. The camphor, in fact, was identical with the camphor of commerce, and was taken from the tree known as "Cinnamomum oliveri." The Commonwealth could also compete against India and Bulgaria with its geraniol extract, for the reason that it combined several products such as perfumes, which in the countries mentioned had to be manufactured separately. The very fact that the Buddah tree so common as a parasitic growth in the dry interior districts spluttered and showed good resinous qualities when burned, went to prove that it held a marketable commodity which might prove of great commercial value. Apart from the trees and shrubs mentioned, the Commonwealth is rich in others capable of being utilised for industrial purposes. Yellow dyes are furnished by the fever bark, cedar, cockspur vine, light yellow wood, "Mallotus discolour", crab-tree, and turmeric tree; red dyes by scrub, or brush blood-wood, red cedar, blood-wood, "Mallotus phillipensis," and mangrove; brown from the brigalow, Queensland-carscarilla, fustic, bitter bark, "Pipturus argenteus," and satin-wood; purple from "Hymenanthera dentata"; sap green from the musk tree, and black from messmate, or stringy bark. Many other vegetable dyes might be mentioned.

Essential oils are obtained from the native sassafras, ridge myrtle,

tea tree, native peppermint, Queensland sassafras, native laurel, dog-wood, sandfly bush and all the numerous varieties of eucalyptus, the oil from which is credited with possessing the power of destroying bacteria or animal life, and may be classed with antiseptics, having an advantage over carbolic acid in the fact that it is not caustic. For medicinal purposes eucalyptus oil has no equal. The richest oil is obtained from the mountain ash, which is found in Victoria, Tasmania, South Australia, and New South Wales. The Victorian blue gum also furnishes an excellent oil. The Australian resin-producing trees include the Moreton, bay pine, sassafras, pink-wood, Port Jackson fig, various kinds of pine, silky oak, beef-wood, sandal-wood, turpentine tree, grass tree, and cheese-wood. Gums and gum-resins are obtained from the candle nut, buny-bunya, pink-wood, native banya, and various kinds of acacia and grass tree. Wattle gum is largely exported for the manufacture of mucilage, cotton printing, and other purposes, being somewhat similar to gum arabic.

AGRICULTURE AS AN ANTIDOTE TO BEGGARY

The State have got such arrangements in Holland that able-bodied persons cannot go a-begging. There are agricultural farms specialy set apart for the unemployed poor. Those who cannot secure employment elsewhere are sent there and given a practical training in farming, after which, some lands on a nominal rental are leased out to them. Thus, one who would otherwise have been an intolerable loafer and a burden on the society was turned into an useful and earning member of it.

The example is worth imitating in this country.

The Salvation Army of England are not content with merely looking after the religion and morals of the poor. They have established farms here and there for their training and maintenance. Many a man who would have otherwise led a degraded life in indolence and corruption, thus found an honourable opening and lucrative occupation and were redeemed thereby vindicating in the truest sense the function of the Salvation Army.

AGRICULTURE AND TIMBER BUSINESS IN SINGBHUM

Any amount of fertile lands is lying fallow in the Singbhum side of the country, which can be had on lease on a nominal rent per year—about Re. 1 per bigha. Collection of jungle or mineral produce of various kinds can be easily done and trading in them also afford means of comfortable livelihood. There is a preponderance of the aboriginal element (like the Sonthals) in the population and the labour is comparatively cheap and plentiful.

Cutting of wood from the forests for sleepers is a flourishing business in these days of continuous railroad extensions all over the country and is being carried on by many with profit.

The one great *desideratum* in this timber business is an effective transport arrangement and there is ample room for profit to a company, if formed, which could regularly supply 300 or 400 carts, with its headquarters centrally situated, so as to be able to command the traffic of widely extended tract.

Singbhum Forest Rules

The *Calcutta Gazette*, dated 28-3-06 publishes revised rules to regulate the registration of property-marks on timber in the Singbhum District and also the transit of timber and firewood in and through that District.

TERMS OF LEASE OF LANDS IN MOYURBHANJ

Open to Modification on Application to the Maharaja According to Circumstances

This lease is granted by the Chief of Mourbhanj to his heirs, executors, administrators, and assigns for the term of 25 years for the waste lands situated within the boundaries.

The conditions of this lease are :—

1. That the lessee shall either himself reside on or near to the lands or his manager or agent with full legal powers to act on his behalf.

2. That all water-courses, creeks, tanks, bunds, roads, the space required for the construction of the lessees embankments, dams, &c. and irreclaimable waste lands shall be for ever exempted from assessment.

3. That for the term of the lease one-fourth of the entire area shall be exempted from assessment.

4. That the remaining three-fourths of the area leased shall be held free of assessment for ten

years and shall be subject thereafter to annual payment at the following rates, namely:—

From the beginning of the 11th year to the end of the 15th year, 2 annas the *man* of 3,338 square yard.

From the beginning of the 16th year to the end of the 20th year 4 annas the *man* of 3,338 square yard.

From the beginning of the 21st year to the end of the 25th year 8 annas the *man* of 3,338 square yard.

5. That one-fifth of the entire area leased, shall be cleared, and shall be in a fit state for cultivation at the end of the fifth year.

6 & 7. Same as the fourth and fifth conditions, page 66, Waste Land Manual.

8. That the amount of assessment due on the land, shall be paid according to the fixed instalments.

9. That all arrears shall be recoverable as arrears of revenue, according to the public demands, Recovery Act (Act I of 1895) or any law for the time being in force.

10. That upon or at any time after the expiration of the term of 25 years, the land shall be open to re-settlement, on such terms as the State thinks fit, provided that the assessment shall not be fixed higher than the rates which would be paid by cultivating raiyats in the neighbourhood for land growing the ordinary crops of the country, less 10 per cent. to be allowed to the lessee to cover the risks and cost of cultivation.

That upon or at any time after the expiration of the term of 25 years, the Chief of Mourbhanj, may at his discretion for ever exempt from assessment an area not exceeding one-tenth of the entire area leased, less the irreclaimable area and water courses, creeks, tanks, roads, &c., where it shall appear that three-fourths of the total area leased is occupied by homesteads or is cultivated or left fallow, according to good husbandry, or otherwise fairly turned to account for agricultural purposes.

That the land shall be subject to any cesses—such as the fuel cess or any other cess—in addition to the assessment to be paid, but the liability of the land to these cesses, shall be left to the discretion of the Chief, after the first period of 25 years' settlement has expired.

11. That the land shall from time to time be subject to resurvey and reassessment.

12. That the land shall be subject to all existing rights of way and water and other easements.

That no charge shall be made for wood and timber standing at the time it is leased, nor for any

wood which may be burnt or otherwise destroyed to effect clearances or used by the lessee or his men for building his or their houses or for other use on the land.

That except as specified above, all wood and timber cut, shall be disposed of by the Forest Department of the State, in such manner as it thinks fit, except that for wood and timber, which the lessee may wish to export for sale or for use outside the area leased, a duty shall be levied at such rate and in such manner as the Chief may prescribe.

13th to 16th. The same as conditions twelfth to fifteenth-page 67 of the Government Waste Lands Manual.

17. That the Chief reserves to himself the right to all minerals on the land. It also retains its proprietory right in the land and only confers on the lessee an occupancy right which shall be hereditary and transferable, provided that within 25 years, no transfer made by the lessee of the whole or a part of the land leased, shall be valid without the sanction of the Chief.

LEASE OF LANDS IN HILL TIPPERA

No hard and fast rules exist at present. There is a vast area to select from and the soil being virgin is, throughout, very fertile.

The procedure about the leases is as follows:—The applicant makes his selection of a site and then submits a formal petition to the Minister at Agartola, who then lays down the terms and conditions which are generally as follows:—

(1) Complete exemption from rent for the first four or five years.

(2) A progressive rent of annas two to four per bigha—the maximum of annas four per bigha being reached in about 10 years.

The right conferred is that of a permanent heritable and transferable tenure.

Babu Purnendu Narain Singh, the well-known pleader and public man of Bankipur holds 12,000 bighas within the state about 18 miles away into the interior from the town of Comilla, on almost the above terms. He intends, shortly, to try cotton on an extensive scale for the cultivation of which crop the State of Hill Tippera is so well reputed abroad.

GWALIOR

One Allahabad Bengalee lawyer, respectably connected, has given up a fair practice and gone to Gwalior to become a farmer there. Two other B.A.,

B.Ls., one from Meerut and another from Mozuffernagar, have followed suit.

A BENGALI AGRICULTURIST IN TRAVANCORE

Mr. Kumud Nath Mukerjee, a young man from Bengal, is now in Travancore. He gave such satisfactory proofs of his knowledge of agriculture before the Maharaja of Travancore that His Highness has engaged him to act as the Superintendent of a model agricultural farm that His Highness has opened in his Capital. It is a patent fact that the scientific agriculturist will be indispensable in the reformed economic life of the Indian nation. He will be deemed a valued agency in the industrial regeneration of the people. It is high time for our youths to apply their attention to this branch of knowledge. Indian agricultural experts must take front rank among the most potent regenerators of India.

FARMERS' BULLETINS

A variety of most useful informations covering a wide range of subjects of vital interest to farmers is contained in a long series of pamphlets published by the U.S. Department of Agriculture and the Bureau of Plant Industry.

The following is a list of the Farmers' Bulletins available for distribution, showing the number and title of each. Copies will be sent free to any address on application to any Senator, Representative, or Delegate in Congress, or to the Secretary of Agriculture, Washington, D. C. The missing numbers have been discontinued, being superseded by later bulletins.

No. 16. Leguminous Plants. No. 21 Barn-yard Manure. No. 22. The Feeding of Farm Animals. No 24. Hog Cholera and Swine Plague No. 25. Pea-nuts. Culture and Uses. No. 27 Flax for Seed and Fiber. No. 28. Weeds And How to Kill Them. No. 29. Souring and Other Changes in Milk. No. 30. Grape Diseases on the Pacific Coast. No. 31. Alfalfa, or Lucern. No. 32. Silos and Silage No. 33. Peach Growing for Market. No. 34. Meats: Composition and Cooking. No. 35. Potato Culture. No. 36. Cotton Seed and Its Products. No. 37, Kafir Corn: Culture and Uses. No. 38. Spraying for Fruit Diseases. No. 39. Onion Culture. No. 42. Facts About Milk. No. 43. Sewage Disposal on the Farm. No. 44. Commercial Fertilizers. No. 45. Insects Injurious to Stored Grain. No. 46. Irrigation in Humid Climates. No. 47. Insects Affecting the Cotton Plant. No. 48. The Manuring of Cotton. No. 49. Sheep Feeding. No. 50. Sorghum as a Forage Crop. No. 51. Standard Varieties of Chickens. No. 52. The Sugar Beet. No. 53. How to Grow Mushrooms. No. 54. Some Common Birds. No. 55. The Dairy Herd. No. 56. Experiment Station Work—I. No. 57. Butter Making on the Farm No. 58. The Soy Bean as a Forage

Crop. No. 59. Bee Keeping. No. 60. Methods of Curing Tobacco. No. 61. Asparagus Culture. No. 62. Marketing Farm Produce. No. 63. Care of Milk on the Farm. No. 64. Ducks and Geese. No. 65. Experiment Station Work—II. No. 66. Meadows and Pastures. No. 68. The Black Rot of the Cabbage. No. 69. Experiment Station Work—III. No. 70. Insect Enemies of the Grape. No. 71. Essentials in Beef Production. No. 72. Cattle Ranges of the Southwest. No. 73. Experiment Station Work—IV. No. 74. Milk as Food. No. 75. The Grain Smuts. No. 76. Tomato Growing. No. 77. The Liming of Soils. No. 78. Experiment Station Work—V. No. 79. Experiment Station Work—VI. No. 80. The Peach Twig-borer. No. 81. Corn Culture in the South. No. 82. The Culture of Tobacco. No. 83. Tobacco Soils. No. 84. Experiment Station Work—VII. No. 85. Fish as Food. No. 86. Thirty Poisonous Plants. No. 87. Experiment Station Work—VIII. No. 88. Alkali Lands. No. 89. Cow-peas. No. 91. Potato Diseases and Treatment. No. 92. Experiment Station Work—IX. No. 93. Sugar as Food. No. 94. The Vegetable Garden. No. 95. Good Roads for Farmers. No. 96. Raising Sheep for Mutton. No. 97. Experiment Station Work—X. No. 98. Suggestions to Southern Farmers. No. 99. Insect Enemies of Shade Trees. No. 100. Hog Raising in the South. No. 101. Millets. No. 102. Southern Forage Plants. No. 103. Experiment Station Work—XI. No. 104. Notes on Frost. No. 105. Experiment Station Work—XII. No. 106. Breeds of Dairy Cattle. No. 107. Experiment Station Work—XIII. No. 108. Saltbushes. No. 109. Farmers' Reading Courses. No. 110. Rice Culture in the United States. No. 111. Farmer's Interest in Good Seed. No. 112. Bread and Bread Making. No. 113. The Apple and How to Grow it. No. 114. Experiment Station Work—XIV. No. 115. Hop Culture in California. No. 116. Irrigation in Fruit Growing. No. 117. Sheep, Hogs, and Horses in the Northwest. No. 118. Grape Growing in the South. No. 119. Experiment Station Work—XV. No. 120. Insects Affecting Tobacco. No. 121. Beans, Peas, and Other Legumes as Food. No. 122. Experiment Station Work—XVI. No. 123. Red Clover Seed. No. 124. Experiment Station Work—XVII. No. 125. Protection of Food Products from Injurious Temperatures. No. 126. Practical Suggestions for Farm Buildings. No. 127. Important Insecticides. No. 128. Eggs and Their Uses as Food. No. 129. Sweet Potatoes. No. 131. Household Tests for Detection of Oleomargarine and Renovated Butter. No. 132. Insect Enemies of Growing Wheat. No. 133. Experiment Station Work—XVIII. No. 134. Tree Planting in Rural School Grounds. No. 135. Sorghum Sirup Manufacture. No. 136. Earth Roads. No. 137. The Angora Goat. No. 138. Irrigation in Field and Garden. No. 139. Emmer: A Grain for the Semiarid Regions. No. 140. Pineapple Growing. No. 141. Poultry Raising on the Farm. No. 142. The Nutritive and Economic Value of Food. No. 143. The Conformation of Beef and Dairy Cattle. No. 144. Experiment Station Work—XIX. No. 145. Carbon Bisulphid as an Insecticide. No. 146. Insecticides and Fungicides. No. 147. Winter Forage Crops for the South. No. 148. Celery Culture. No. 149. Experiment Station Work—XX. No. 150. Clearing New Land. No. 151. Dairying in the South. No. 152. Scabies in Cattle. No. 153. Orchard Enemies in the Pacific Northwest. No. 154. The Fruit Garden: Preparation and Care. No. 155. How Insects Affect Health in Rural Districts. No. 156. The Home Vineyard. No. 157. The Propagation of Plants. No. 158. How to Build Small Irrigation Ditches. No. 159. Scab in Sheep. No. 161. Practical Suggestions for Fruit-

Growers. No. 162. Experiment Station Work—XXI. No. 164. Rape as a Forage Crop. No. 165 Culture of the Silkworm. No. 166. Cheese Making on the Farm. No. 167. Cassava. No. 168. Pearl Millet. No. 169. Experiment Station Work—XXI No. 170. Principles of Horse Feeding. No. 171. The Control of the Codling Moth. No. 172. Scale Insects and Mites on Citrus Trees. No. 173. Primer of Forestry. No 174. Broom Corn. No. 175. Home Manufacture and. Use of Unfermented Grape Juice. No. 176. Cranberry Culture. No. 177. Squab Raising. No. 178. Insects Injurious in Cranberry Culture. No. 179. Horseshoeing. No. 180. Game Laws for 1903. No. 181. Pruning. No. 182. Poultry as Food. No 183. Meat on the Farm.—Butchering, curing. No. 184. Marketing Like Stock. No. 185. Beautifying the Home Grounds. No 186. Experiment Station Work—XXIII No. 187. Drainage of Farm Lands No 188. Weeds Used in Medicine. No. 189. Information Concerning the Mexican Cotton Boll Weevil. No. 190. Experiment Station Work—XXIV. No. 191. The Cotton Bollworm. No. 192. Barnyard Manure.

AGRICULTURE AND GOVERNMENT : AMERICA, AND INDIA

In America the State Department of Agriculture sends seeds, plants, and all its publications to the farmers, whilst every member of Congress is made use of as an agent to push the latest discoveries of agricultural science before the farming members of his district. It is not the case of the farmer having to apply. The Government having made an useful discovery at once informs every farmer directly. If that be the policy with an educated and enlightened community possessed of capital, how much greater is the need for the Government of India to force upon the ignorant, and impoverished ryot, the lessons gained by knowledge and experience. It behoves the Government therefore to stir itself into an active policy if India is ever to be dragged out of her backwardness, and we feel that His Excellency Lord Minto, bringing with him as he does the knowledge of a landholder, and the experience gathered in a great agricultural dependency of the Crown, will recognize the particular need in India for a policy of push in this Department of the Government. He has in Pusa the nucleus of a great and far-reaching power, it remains only to direct its energies to practical utility.

PROPOSED HORTICULTURAL CLUB OF INDIA

Mr. S. P. Chatterji of the Victoria Nursery, proposes to establish a Club, called the "Horticultural Club of India," with the object of bringing together all enthusiastic horticulturists in the country, and diffusing a knowledge of gardening in the most

practical way. To this end, he proposes as often as possible meetings and shows during the year, and also to get together an up-to-date Horticultural Library. Lord Kitchener and Sir Andrew Fraser will be the patrons of the Club, Mr. Holmwood, I. C. S. President, and Maharaj-Kumar Sir Prodyot Kumar Tagore, Kt., Vice-President. The Board of Directors consists of 12 members, of whom three are Indians.

The Plantain

THE TREE AND ALL ABOUT IT

A Most Profitable Cultivation

There is a common saying in Bengal that one who can plant 360 plantain trees, may live comfortably all his life. This saying is very true and if any body plants 360 plantain trees he can at least earn Re. 1 per day or Rs. 360 per year, which is a handsome income to a middle class simple villager who has nothing to buy, from outside, except salt and oil for his daily food, and cloth for dress.

There are several species of plantain tree of which the following are the principal ones, *viz*:—*Plantago Alisama*, *Musa Lanceolata* and Major. Of all the above the Musa kind is the principal and bears the fruit known as the plantain fruit.

It is very largely consumed as a fruit when ripe, by all classes of people both rich and poor, and in its green state the people boil it with water or rather cook it and make many delicious vegetable dishes. Thus it is useful both when ripe and unripe and in either case it is one of the best eatables obtainable in the country.

The leaves are freely used by the people of the country as plates and dishes to take their rice from. The trunk and flowers are used as vegetable food and very good curries are made out of them. Thus every part of the tree has its value.

The ashes obtained by burning the leaves, sheaths, roots, stumps and husks of the fruits is used in this country by Dhobis and low-class people as cloth-washer and is in no way inferior to soda or soap. The portion of the plant lying underground may also be used as food. During the terrible famine in Behar, some people had the misfortune to live upon it for sometime. This they boiled and ate.

The honey obtained from the flowers of this plant is superior to any other except that of lotus, orange or oil-seed (country mustard) flowers.

The fruit is very nutritious and in respect of starch and nitrogen

is even richer than wheat. Very nice flour is made out of the fruit when green.

The plantain tree is also an excellent fibre-yielding agent (vide later). Its cultivation deserves to be taken up in right earnest by those who want to add to the country's wealth at the same time enrich themselves.

THE PLANTATION AND ALL WORTH KNOWING ABOUT IT

Practical Hints from an Expert

Plantain is a native of tropical countries. It is hardly seen to grow in other countries. It may, however, be grown scientifically in places beyond the tropics at an enormous cost of both labour and money, but with no better success. Plantain is indigenous to Asia and America where it grows spontaneously.

Plantain is known in different parts of the country by different names. One sometimes finds people using the word bannana for plantain in general. Plantain or Musa is the general name for plants of this genus no doubt. Bannana is a sort of American plantain and may be included in the list of plantains, though it differs in shape and form from the plantain trees of Asia. As for instance *Musa Ensette* (a kind of American plantain) belongs to bannana class and is in many respects different from Asiatic plantains. Plantain derived its name from the French and Latin root "*Plantago*" and is generally called *Musa Sapientum*. Bannana derived its name from the French root "*Bannane*." From this it is apparent that there is some distinction at least between bannana and plantain, though they both belong to the same family or genus, and possess the same nature and habit. The leaves, blossoms, and fruits of bannana trees differ greatly in shape from our Indian plantains. The leaves of bannana trees are longer and broader than the leaves of Indian plantain trees. The cluster of fruits is also different. According to Mr. Roxburgh, the well-known botanist, it is a distinct variety of plantain.

Report below will show, how minor industry may attain to the rank of a staple product by encouragement :—

"The banana cultivation of Jamaica, a case in point, may be cited as a most striking and remarkable instance of how a minor industry may under suitable encouragement, attain to the rank of a staple product.

"Twenty-five years ago, the value of the bananas exported from Jamaica was practically nothing. People then grew them for their

own use, but never thought of shipping them. In the year 1892-93, the value of the bananas exported from Jamaica reached over £400,000; it exceeded that of either sugar, coffee or dye-woods. In this case a minor industry of comparatively unpromising character has been called into existence and so advanced in value as to overtop old industries, carried on for more than a hundred years."—(Kew Bulletin, October, 1894).

In those Islands and in Australia, New Zealand, Borneo, Sumatra, Jaya, Strait Settlements and Singapore, the cultivation of plantains and bananas is so very extensive that every year they export dried fruits worth several lacs of Rupees, to other countries.

From a Report of the Trinidad experimental farm we find 15 lbs. bunch of plain bananas yields 3 lbs. of flour. Each lb. of flour is sold in London market at 6*d*. or six annas. An acre of land produces about a ton of flour. According to the above scale the income per Bigha is Rs. 243, as will appear from the table annexed below :—

The produce of an acre (3 Bighas 5 Cottas) is one ton or 27 maunds flour.

The produce of a Bigha is therefore 8 maunds 4 seers, sold at twelve annas (one shilling) per seer, brings an income of Rs. 243.

Deduct cost of cultivation per Bigha according to the scale to be shown hereafter,—Rs. 56.

Deduct also shipping cost including all charges at the rate of four annas per seer upto London on 8 maunds 4 seers...Rs. 81.

137.

Net profit per Bigha is Rs. 106.

The above estimate, of course, is for flour obtained from dried fruits. Fresh ripe fruits are sold at high price locally. If you have 100 Bighas of land at your disposal you can easily earn Rs. 10,600 yearly by a nominal outlay of Rs. 5,600 only. Ginger and turmeric may be cultivated in plantain field or garden. That also brings a handsome additional profit.

There is a great demand for this fruit in the market. There is no place in the world where it is not sold at high price. According to the quality and flavor of the different varieties of this fruit, the price ranges from one fruit per pice to six, in our country. There are some places abroad, where each *Saffari Kala* (the best variety of plantains) is sold at two to six annas. Each "*Kandi*" contains five to thirty bunches of fruits. Each bunch again contains five to twenty fruits. If we fix the average produce at 10 × 10, it will give you at least 100 fruits at the lowest rate.

If you sell them at five per pice, your income will be five annas per plant, per year. You will get three crops in succession from the same clump of three plants yearly. That brings you about fifteen annas or a Rupee per clump yearly. If you have 360 clumps of three shoots you get Rs. 360 yearly or one Rupee daily. If you have 1½ bighas of land you can plant 384 plants at 8 cubits or 12 feet apart. This will bring about Rs. 384 a year. Deduct from this the cost of cultivation, as shewn below:—

COST AND OUTTURN OF 1½ BIGHAS

	Rs.	As
Total sale proceeds as shown before	384	0
1. Ground-rent	3	0
2. Cost of digging	7	8
3. „ ploughing	5	0
4. „ Laddering and breaking clods etc.	1	8
5. Weeding jungles and after-treatment	6	0
6. Price of 384 shoots at half anna each	12	0
7. Planting including digging pits	10	0
8. Watering	2	0
9. Supplying new earth to the plants	27	0
10. Contingencies :—Such as carting plants to the site and other expenses such as driving and killing injurious animals and worms, etc.	10	0
Total Cost	84	0
Total profit per year	300	0

Now, your profit for 1½ Bigha is Rs. 300 after deducting the cost of cultivation as shewn above. No other crops will give you such a big profit. According to the above scale, the profit per bigha is Rs. 200 and the cost of cultivation Rs. 56 only. The produce per clump of three shoots as estimated above has been fixed at the lowest rates and the cost of cultivation at the highest rates. Generally, we get no less than Re. 1-8 per clump every year. In that case your annual income would be about (300 plus 192) Rs. 492 for a bigha and a half, or Rs. 328 per bigha. One will no doubt wonder to hear that such a handsome profit may be derived from such a minor industry. But we will say from our experimental knowledge that it is really so.

"Plant three hundred and sixty clumps of plantains. Then go home and sleep all time. Never cut the leaves of your plants. They will provide you with food and clothing."

The following are the English renderings of some of the Bengali proverbs current in the country regarding the cultivation of plantains.

"Fresh cow-dung is good manure for betel-nut plants, and new earth for plantain trees. The root of cocoanut trees should be cut before fruition."

"If plantain trees are planted in Falgoon, they will grow into big clumps readily and will produce so many fruits that will break one's shoulder to carry them."

"Ravana (King of Çeylon in Rama's time) says if you plant plantain trees in Ashar and Sravan you will hardly find it necessary to go to your plantation and will hardly gather any fruit. Earth-worms will destroy the plants which will consequently fall on the ground."

"Plantain trees planted in Falgoon, bear fruits every month."

"Ravana was ruined with his whole family because he planted plantain trees in Bhadra."

There are various other proverbs prevalent among the cultivators of this country bearing on the cultivation of plantain.

LIST OF THE DIFFERENT VARIETIES OF PLANTAIN

Different varieties of plantain available in India, especially in different parts of Bengal, are,—

1. *Anupam*—(the unsurpassed), *Saffri or Subri kola*—Flavour excellent, substance yellowish and very soft and has no seeds. Available in all parts of Bengal. Ripens in three months after blossoming.

2. *Amrito Sagor*—(Sea of nectar). Similar to the above, but superior in flavour. Available in abundance in Rampal in Munshigunj Sub-division, Dacca.

3. *Dudh Sagor*—(Sea of Milk). Substance of a milky white in the unripe state, flavour good. Extensively cultivated in Rampal.

4. *Daccai Martaban*—originally imported from Martaban of which it is a native. *Daccai Martaban* seems to have taken its name from it. Flavour very good and sweet, substance yellowish with no seed ; available in all parts of Eastern Bengal, especially in Dacca.

5. *Baghnali*—(Tiger's fore-finger) so called because of its resemblance in shape with tiger's fingers. Flavour good, substance yellowish with no seed. Available in Rampal where it has extensive cultivation.

6. *Mohun Bashi*—(The charming flute). Is a degenerate variety of *Suffri*. Flavour good, substance whitish, extensively cultivated in Rampal.

7. *Kanai Bashi*—(*Kanai* or Krishna's flute). Has some resemblance with horn, curved in shape. Flavour good, substance yellowish. Has no seed. Available in Rampal.

8. *Agniswar*—(God of fire). Both plant and fruit are of a fiery red. The leaves are also red. Flavour good. Has no seed. Available in Rampal.

9. *Jati*—(Ordinary plantain). Available everywhere in Bengal. Flavour not so very good as that of the foregoing varieties, used in making cakes etc. Substance yellowish, has seeds.

10. *Amritoman.* 11. *Kabri.* 12. *Goma.* 13. *Aina Mugar.* 14. *Madna.*—All these are similar to *Jati.* *Flavour is also like Jati. Substance yellowish. Have seeds.* Available in different parts of Bengal.

15. Penang—Is a native of Pulu Penang in Malya. Flavour good. Substance yellowish. Has no seeds.

16. *Cavandeshi* or *Kabuli*—Is a native of China of a dwarfish size, sometimes called *Jahajoy.* Yields large bunches of fruits nearly equal to the size of the plant itself. Flavour good. Very soft. Substance yellowish. Has no seeds. Available almost in all parts of Bengal. Is called *Gogee Kale* in Bombay.

17. *Champa.*—Is called *Sonkale* in Bombay.

18. *Chini Champa.*—Flavour good. The latter is sweeter than the former. Has no seeds. Available everywhere in Bengal.

19. *Ram Kola*—Red. Flavour good. Has no seeds. Available in some parts of Bengal. Is called *Raj Kola* in Bombay.

20. Beef Java Red. Similar to the above. 21. *Kanthali.* 22. *Kalibow.* 23. *Chatim.* 24. *Hajari-Champa.* 25. *Thotay.* 26. *Kurbut.* 27. *China Kanthaly.* All these are of less importance as their flavour is not so good as that of the foregoing ones.

28. *Tula athia.* 29. *Kerkeri athea.* 30. *Bhim athea.* Flavour good, substance white, very soft. Full of seeds. Not eatable.

31. *Chhagol Batea.* Giant variety of *athea, similar to Tula athea. Flavour good. Sweeter than all the above. All these* varieties yield good fibre.

32. Singapore—Several varieties available of good flavour.

33. Rangoon.—Only one variety known which is not good.

34. *Musa Zebrina.*—Is a native of Sumatra. Fruits not eatable. The plant is very ornamental.

35. *Bombai.* 36. Bombay musk. 37. Bombay Dwarf. 38. Goa Variety. 39. *Mulaly* or *Multanee.* 40. *Elachi.* 41. Giant (Bombay). 42. *Bella.* 43. China. 44. China Red. All these plantains are imported from different parts of India. They thrive well in many gardens, but have not yet borne fruits.

45. *Musa Superba.*—Is a native of southern India. Very ornamental.

46. Madras.—Native of Madras. Not mature yet.

47. *Donrep*—Important for leaves only.

48. *Donreh*—Important for leaves, plant, and for fibre. Fruits not eatable. 49. (*a*) *Musa Chinensis*, ornamental. (*b*) *Musa Rosea*, ornamental. (*c*) *Musa Rubra.*—*Tham Kola* or pillar plantain, very ornamental. 50. *Musa Ensette.*—American Banana. 51. *Musa Reli-*

giosa—Habits not known yet. 52. *Musa Ornata*—Native of Chitagong; Monkey's plantain. 53. *Musa Glauca*—Is a native of Pegu in Burma. Monkey's plantain. 54. *Musa Coccinea*—Very ornamental.

CURRY OR VEGETABLE PLANTAIN

55. *Lumbir.* 56. *Bura Buglow.* 57. *Katu Bhusan.* 58. *Pantarash.* Several other varieties available.

CEYLON OR SINHALESE PLANTAIN

59. *Kolikotta*—Good flavour. 60. *Suvandel.*—Similar to the last. Has sweet smell. 61. *Ambal honarawala*—with sweet and sour in taste 62. *Rotabonarawala.*—Very sweet. 63. *Pushpa Kadali.*—A sweet-scented variety of good flavour. 64. *Navari.*—Fingured plantain, very sweet. 65. *Megoanawala.*—Curry plantain bearing large green fruit. 66. *Hapuanawala.*—Short fruited curry plantain. 67. *Atikehel.*—Wild variety, yields best fibre. 68. *Alukehel.*—Ash coloured fruits, used in curry. 69. *Mondan.*—Ash coloured fruits, used in curry. 70. *Rath Kehel.*—Red curry plantain. 71. *Martwala.*—Potato flavoured curry plantain 72.—*Kan..naru*—green coloured curry plantain. 73. *Kitalu.*—Fragrant curry plantain.

Additional list of plantains cultivated in the Bombay Presidency or Western India :—

74. *Kabe.* 75. *Goosavee.* 76. *Bottattee.* 77. *Lokandee.* 78. *Rasa Bali.* 79. *Raja Rasabali.* 80. *Patta Bali.* 81. *Patta Gogoondi Bali.* 82. *Madharanga.* 83. *Gujja China.* 84. *Gular Bali*—Butter plantain. 85. *Chandra Bali*—Red plantain. 86. *Sakialati Bali*—Red cotiteny. 87. *Pacha Bali*—green, even when ripe. 88. *Haon Bali.* 89. *Velatri Bali.* 90. *Arisma Bali* or *Ane Bali*—A very large kind of plantain. 91. *Kalyani Ball.* 92. *Budhi Ball.* 93. *Musa uranoscope*—Queen'sland ornamental banana. 94. *Musa Sapin turmilalla*—ornamental.

Note.—In the Tamil, Telegu and Sinhalese languages the words "Kehel or Kale" means Kola or Kela.

Tobacco

ITS CULTIVATION

The large increase of some 36,000 acres in *tobacco cultivation in Bengal* in 1903-04 as compared with the preceeding year has occurred mainly in the districts of Puri, Cuttack, Monghyr, Rangpur, Jalpaiguri, Jessore and Nuddia, where the people are paying more attention to the crop, it being a profitable one to grow, the demand for home-grown tobacco having increased, in the Province.

Most of the influential papers are now writing about Tobacco

and Tobacco cultivation. They are of opinion that there is a vast room for improvement and there is no reason to suppose why Indian tobacco will not hold its own against imported varieties.

Tobacco is the most extensively used narcotic or stimulant known in the world and in India it is used in various ways. Smoking tobacco is a universal practice amongst all classes of the Indians, in various forms. Next to smoking comes its use as snuff and chewing raw tobacco is also prevalent nearly amongst all classes of people. In short, in one or other form, tobacco is used nearly by about ninety per cent. of the people of India. Hence tobacco occupies a very prominent position amongst the vegetable products of India and is therefore extensively grown nearly all over the country.

How it came to be first introduced into this country or whether it is an indigenous plant of India, there is no authentic record to be found anywhere in the history of India, but it is more than evident that the ancient Aryans were not fortunate enough to include the delicious and invigorating smoke of this sweet scented herb amongst the many enjoyments they used to indulge in, during the golden age, in as much as there is no mention of it anywhere either in the Vedas or Puranas. Therefore it may be easily surmised that it is a later addition to the long list of narcotic stimulants used in India.

According to the Europeans the birth-place of this most universally used drug was America and the first discoverer of it was Columbus.

There is an inexhaustible demand for tobacco all the world over and really good leaves always fetch good prices.

At present the cultivation is practically confined to the districts of Northern-Bengal, Dinajpur, Rungpur and neighbouring tracts.

Both production and quality can be immensely improved with the help of manures and application of up-to-date scientific processes which are beyond the scope and power of poor illiterate cultivators.

Curing leaves and cigar-making also afford a highly remunerative scope for the exercise of scientific knowledge and capital.

An Estimate of profit and loss per Acre

	Rs.	As.	P.
Land 1 acre (about 3⅓ bighas)			
Ploughing, at the rate of Re 1-8 per bigha	5	0	0
Seeds	1	0	0
Cow-dung manure 60 mds. @ ans. 8 per maund	30	0	0
Subsequent care for 4 months by 1 man @ Rs. 8 per month	32	0	0

	Rs.	As.	P.
Rent of the land @ Rs 4 per bigha.	13	8	0
Subsequent expenses for harvesting, drying and curing the leaves	5	0	0
Total ..	86	8	0

Thus we find that the highest cost to grow tobacco per acre is about Rs. 86-8 taking for granted that the cultivators have to purchase the cow-dung at the above high rate, which in reality they have either had not to do at all or may have to do partially. Now the average production is about 6 mds. per bigha or about 20 mds. per acre (which may be increased if better and larger quantity of manure is used) out of which quantity there will be about 7 to 8 mds. of inferior tobacco called *Bishpath* and old leaves and the balance 12 to 13 mds. will be *Polo* or better tobacco.

	Rs.	As.	P.
8 mds. of Bishpath @ Rs. 3-8 per maund at the lowest	28	0	0
12 mds. of Polo, considering the quality to be very low, @ Rs 10 per maund	120	0	0
Total ...	148	0	0

Thus there is a clear net profit of about Rs. 61-8 per acre or nearly 70 per cent. of the gross capital outlay. This profit may be very greatly increased if better manures are used and more vigilant care is taken on scientific principles. Even as it stands, this profit is very satisfactory and any one with a capital of about Rs. 500 may easily earn about Rs. 30 per month, on an average, if not more. He may invest this capital over again in growing other crops such as potato, jute, &c. during the remaining 8 months and can get another equally good return. Thus there is every chance of more than doubling one's capital in a single year.

As in all vegetable matters the component parts of tobacco consist of three things, namely, water, mineral acids and bases (when burnt become ashes). The greater part of the ashes consists largely of potash, salts (KCl, K_2CO_3, K_2SO_4) which may amount to from 5 to 35 per cent. It is remarkable that tobacco contains no soda.

Nicotine is the matter which gives strength to tobacco, but not its flavor or aroma. The manure supplied to a tobacco field does not improve its Nicotine but increases the weight of the crop.

Nicotine is the substance which affects the brain of the user and imparts to him that pleasure which a smoker or a user of tobacco in any other forms, enjoys. Though this Nicotine is the real giver of pleasure to the user of Tobacco, it is very injurious to his health and less the quantity he imbibes the better it is for him. In this respect,

the smokers of cigars are more liable to imbibe this Nicotine poison in much larger quantity than the smokers of *hookah* (huble-buble)—a kind of contrivance by which the smoke is made to come through the water placed at the bottom of the cocoanut shell. This water, thus placed, does not only reduce the quantity of Nicotine which is soluble in water, but also makes the smoke much cooler than when it is smoked from a cigar. Scientific Europe or America is far behind in this respect than India, although the use of tobacco must have been introduced into all these countries nearly at the same time.

There are several ways of increasing or reducing the percentage of Nicotine in the leaves of tobacco if any one desires so to do. If the plants are put wide apart, allowing sufficient space between them, they grow vigorously and the leaves become, heavier and thicker as well as richer with Nicotine than if they are planted quite close to each other when the leaves generally become thinner and less vigorous and contain much less percentage of Nicotine. But Nicotine makes the leaves stronger and therefore help to fetch more value for the leaves—hence it is to the interests of the cultivators to see that there may be greater percentage of this poison in the leaves they grow.

There are several varieties of tobacco grown in different parts of the world of which the one grown in Venezeula is considered to be the best in flavor, aroma and Nicotine. This variety is known under the name of *kanaster*—a name given to it from its peculiar packing for export in a kind of wicker baskets called *kanastra*. Next to this Tobacco comes the kind of Tobacco leaves shipped from the United States of America which are also very good and very much appreciated in Europe specially in the United Kingdom. Turkish Tobacco, which also is very good in flavor comes next to what is grown in Venezeula and Cuba. This Tobacco is grown in the province of Syria in the Asiatic Turkey and is known under the name of *Latakia* and is very much liked by the smokers of Europe and fetches very good prices.

In Europe there are several preparations of Tobacco known under various names, such as, Smoking Mixture, Roll Tobacco, Cake Tobacco, &c. &c. These different kinds of tobacco are specially manufactured out of tobacco leaves to suit different purposes. We have, however, no such preparations in India—and the only one that is in use here, is called *Goorook* or smoking tobacco which is smoked by the Indians in *chillum* with the help of huble-bubble.

TOBACCO—A VERY PAYING CROP IN THE BOMBAY PRESIDENCY

Tobacco, like sugarcane, is also a very paying crop in the Bombay Presidency. At present, it is of special importance in the Kaira and Belgaum Districts. The total tobacco area of the presidency is under 100,000 acres. The crop requires high cultivation and when successful can, it is said, pay a profit of over Rs. 100 per acre. Some two decades ago, experiments were made by Government to improve either the cultivation of the plant or the curing of the leaf by European methods, but with no favourable or tangible results and were in consequence abandoned. Interest in the matter has again recently been revived in the Bombay Presidency where the authorities are reviewing the experiments in cultivation at Nadiad and have ordered the construction of a curing-house in connection with them. If these experiments lead to practical results and tobacco cultivation is taken up on the right lines another most remunerative investment will be thrown open to capital in Western India.

USING PASTE IN CHEROOTS AS AGAINST THE MOULMEIN SYSTEM OF TYING UP THE ENDS

A correspondent says: *Burmese manufacturers of cheroots* are not as careful as they might be of the quality of the paste they use, and the cheroots suffer in consequence. Sago or arrowroot is generally used, but it is not often freshly made. Many years ago, manufacturers in Moulmein used to tie the end of the cheroots with Turkey red yarn instead of using paste, and smokers then had only the flavour of the tobacco leaf with their cheroots uninjured by ancient paste. For some reason or other the manufacture of these tied cheroots was abandoned probably on account of the greater trouble involved in the making as compared with the use of paste. If some manufacturers tried the old tying up system with the best tobacco leaf they would probably be surprised at the popularity such cheroots would acquire.

A TIMELY SUGGESTION

Tirhut (Districts of Mozuffarpur and Darbhanga, B & N.W.R.) is a great centre of the tobacco trade, where Labour is also very cheap and plentiful. A cigarette or '*biri*' business, if started here, is bound to be lucrative and it can be taken in hand with a small capital.

There was once a factory at Pusa which can be revived.

TOBACCO & OFFICIAL SCHEME OF EXPERIMENTS

In connection with an official scheme of experiments for the improvement of Indian tobacco

which has been evolved by the Board of Agriculture, it has, we see, been proposed that the area for experimental work should for the present be confined to the following tracts :—(1) The Coimbatore and Dindigul tract of Madras ; (2) The Godavari delta of Madras ; (3) The Rangpur tract of Eastern Bengal ; (4) The Delta tract of Burma ; (5) Behar in Bengal ; (6) Gujrat in the Bombay Presidency. The main objects of the experiments are to be to test the possibilities of producing tobacco for European consumption suitable for (1) Cigar wrappers, (2) Cigar fillers, or (3) Pipe and cigarette tobacco.

The Castor-Oil Plant
GENERAL NOTES

[Reference : Dr. Watt's Dictionary of Economic Products, Vol. VI., Pt. I., R. 369—486]

Some botanists think that castor-oil plant is not a native of India but that it has spread from Africa. But the plant has been seen to grow quite profusely in the outer Himalayas at a considerable distance from human habitation. Besides, in the plains, the plant is seen to grow uncared for on waste-lands with luxurience.

SOME USES : Castor-oil is frequently used by dyers and calico-printers of India and elsewhere and by tanners as a dressing for tanned hides and skins. It is also used as a preservative of leather-goods from wet. The leaves of the plant yield food for that important & valuable *eri* silk-worm cultured in Assam. An excellent paper-pulp is said to be made from its bark and stem. For efficiently lubricating all kinds of machinary, as a lamp-oil yielding white light without soot, as a material for the manufacture of soaps, candles, pomatums and perfumed hair-oils, no better agent can be found. The use of the higher class oil in medicine as an infallible purgative is too well-known to need much comment. The castor-oil cake is very valuable as a general manure and has almost become indispensible for sugar-cane, potatoes and wheat cultivation. There is a popular nation amongst the farmers of India, not uncorrobarated by facts, that, fed on castor plant leaves, cows yield more milk.

CULTIVATION : The castor-plant is cultivated extensively in Behar and in Orissa and in certain parts of Bengal, though not so extensively. The plant likes a loamy soil enriched by siltdeposits of river banks. The seed is generally sown in *Kartik* and is harvested in *Paus*. The seed after being picked is sunned for 3 or 4 days. It is then husked when it is ready for the market. The average yield of seed per acre is 3 maunds.

P. R. C.

ITS CULTIVATION IN CEYLON

(EXTRACT)

The castor-oil plant *(Ricinus communis, Linn.)*, a native of North Africa, is without question thoroughly naturalized in Ceylon. This product is largely cultivated in the tropics, in climates similar to those prevailing in many parts of this island. A series of experiments has therefore been made to determine whether it is possible to profitably cultivate this product at Peradeniya.

If the castor-oil plant could be successfully cultivated in Ceylon, there would be a fair outlet for the cake and oil obtained from the seeds. The following table shows the imports to Ceylon in the years 1899—1903, inclusive :—

	1899.	1900.	1901	1902.	1903.
	Cwt.	Cwt	Cwt.	Cwt.	Cwt.
Castor cake ...	129,535...	...—	...134,6[illegible]	...141,[illegible]	
Castor-oil ...	5,[illegible]92 ...	5,991	.5,189...	6,264...	4,779

Castor-cake has now taken its place as a constituent of manures for tea, cocoa, and cocoanut . It contains from 5 to 7 per cent. of nitrogen and varying proportions of phosphoric acid and potash. There is likely to be an increase in the demand for this relatively stable manure. The oil is extensively used for medicinal and other purposes, and no less than 1,410 tons have been imported during the last five years.

The work done at the Experiment Station has proved that this product is one which is not likely to be taken up in preference to those already thriving in this district. There is, however, opportunity for further experiments in the Northern Province, and new varieties are still being introduced.

The castor-oil-plant has not been cultivated on a large scale in Ceylon, and is at present mainly confined to native compounds. The parent-seeds have most probably been introduced from India without regard to their relative values as crop-producers, and scattered plants of different varieties are now met with from sea-level to 6,900 feet.

The experiments were commenced at Peradeniya in 1902 and have been continued upto the present date. The Indian varieties experimented with have been obtained through the kindness of Major Prain, Superintendent, Royal Botanic Gardens, Calcutta, and C. A. Barber, Esq., Government Botanist, Madras.

VARIETIES

Madras variety.—This variety is distinguishable by its small habit and light-blue coating of wax over stems and leaves. The leaves, fruits, and seeds are smaller than the other varieties mentioned here. The fruit is about 15 mm. ($\frac{5}{8}$ inch) in diameter, and its wall

is covered with soft attenuate structures measuring 5 mm. ($\frac{1}{8}$ inch) in length.

The seeds of this variety are very small and comparatively heavy. They usually measure $1\frac{1}{2}$ mm. ($\frac{1}{16}$ inch) in length and 6 mm. ($\frac{1}{4}$ inch) in width and about 2,440 fresh seeds weigh 1 lb.

Patna variety.—This variety in point of habit comes between the Calcutta and Madras varieties. The stems and leaves are coated with a thin layer of bluish wax, which is easily detached. The inflorescence possesses a very large number of flowers, which are very compact, and form an erect pyramidal mass unlike what is seen in other varieties. A single inflorescence measures from 16 to 35 cm. ($6\frac{1}{4}$-$13\frac{1}{2}$ inches) in length, and may bear over 70 fruits. The fruit is about 20 mm. ($\frac{3}{4}$ inch) in diameter. The spines are longer than in any other variety, and measure 10 mm. ($\frac{3}{8}$ inch) in length, or half the diameter of the fruit.

The seeds vary from 12 to 6 mm. ($\frac{1}{2}$—$\frac{3}{8}$ inches) in length, and are invariably larger than those of the Madras variety and smaller than the Major.

Major variety.—This is a perennial variety of castor-oil. It differs from all other in the very large size of the leaves, fruits, and seeds. The fruits measure 35 mm. ($1\frac{3}{8}$ inch) in diameter, and are covered with short, green spikes, 6 mm. ($\frac{1}{4}$ inch) in length; there may be as many as 20 fruits in each inflorescence, the latter measuring when open 25cm. (10 inches) in length. The seeds are 20 mm ($\frac{3}{4}$ inch) long and 15 mm. ($\frac{5}{9}$ inch) wide. The stems and fruits are deep-green in colour, and are not covered with a layer of wax as in certain other varieties.

Calcutta variety.—This variety in good soil, grows to a larger tree than any of the other varieties.

Method of Cultivation

The Government Botanist Madras, states that the land is ploughed twice after the rains land in July and August, and the seed is sown by dropping it in the plough furrow. Another plough which follows covers the seed. A month after planting, when the plants are one foot high, the land between the rows (which are a yard apart) is ploughed once or twice. This product is, in parts of India grown in rotation with others.

At Peradeniya, unmanured land has been turned over by mammoty-forks, and after a little levelling the seeds have been sown by hand. The castor-plant was grown as a single product and has been followed by Indian corn and ground nuts.

The seeds of the different varieties were sown at varying distances according to the habit of the mature plants.

Growth and Harvesting

Madras variety.—The seeds can be planted 3 feet by 3 feet apart (closer than any of the foregoing varieties), and bear fruit a few weeks earlier than the Calcutta variety.

One plot planted on the 20th April was ready for picking on the 21st August, the crop rising to its maximum during September and October and dying back in November. The crop-period might have lasted longer had the plants been free from the attack of fly, though a cropping-period extending over two to three months seems to be what one may expect. In November and December this plot produced abundance of new leaf.

Patna variety.—Seeds can be sown 4 feet by 4 feet or 6 feet by 4 feet apart. The growth in the seeding-stage is rapid, the plant attaining a height of 6 to 10 feet in five months. The crop may be expected four to five months after sowing.

Major variety.—The plant grows very rapidly, attaining a height of 6 feet with a stem 2 inches in diameter in five months. The seeds were planted towards the end of February, flowers appeared in May, and fruits were ready for picking in August. The best distance for this variety is about 10 feet, as the branches are large and numerous.

Calcutta variety.—It was originally planted 3 feet by 3 feet apart, but twice this distance is the minimum to be allowed, as within four to five months, the plants are 5 to 6 feet in height and well branched.

Transplanted seedlings are very backward in their development. The crop is ready for harvesting four to five months after planting seed at stake, or five to six months from transplanted seedlings.

The fruits are collected by hand. When one or more fruits, in an inflorescence are ripe, the whole of the latter is detached and dried in the sun. During drying, the seeds are liberated, and the husks are separated from them by winnowing.

The Potato

GENERAL NOTES

Potato, botanically known as *Solanum tuberosum*, is a most largely used vegetable in the world. There is scarcely any vegetable curry where this most valuable esculent does not form the principal part. It occupies the next place in importance to rice amongst the food stuffs of the vegetarian Hindus.

Potato is not a native of India, but was brought here by the Spaniards who met with it, in the neighbourhood of Quito where it

was cultivated by the natives, nearly 300 years ago.

Potato owes its value to the peculiar habit of developing underground slender leafless shoots or branches which differ in character and office from the true roots. These roots gradually swell at the free ends and produce the tubers known so well to us as Potatoes. These tubers have eyes or leaf-buds from which again they send forth leafless branches each of which again produce a tuber. Thus from one plant there may be many tubers, the number and bulk of which depends entirely upon the nature of the ground on which the plant is grown.

Sandy and consequently loose soil is best suited for its growth, whereas, hard and sticky soil is not at all suitable. Before planting, the ground must be very well loosened by plough or hoes and well-manured. Of all manures, castor-cake, rotten cow-dung, bone-meal are the best, and one must be very careful to put sufficient manure on the ground to get good result, otherwise the result will be unsatisfactory.

Its value as an article of diet consists in the starch it contains and to a less extent in the potash and other salts. On account of its containing Nitrogen only in a very small proportion, it cannot be independently used as a staple article of diet. When analysed, potato has been found to contain the following, *viz* :—

Water	...	75	per cent.
Starch &c.	...	18·8	„
Sugar	...	3·2	„
Nitrogenous matter		2·1	„
Saline matter	...	0·7	„
Fat	...	0·2	„
		100	

There are about 600 different species of potato, of which only a few—say, about a dozen—are known to the ordinary people. All these different species contain nearly the same chemical composition and may be cultivated in nearly the same manner. When grown wild, the tubers are not earthed up in the same way as they are when regularly cultivated. They generally become small and lie close to the surface of the soil or even above it. They then become green in colour and acid in taste and are not very wholesome as food.

ABOUT POTATO-CULTURE

Practical hints from an expert-grower in Bengal

Mr. Iswar Chandra Guho, Jamalpur.
Mymensingh, Bengal.

Sorting :—As soon as you have gathered your crops, you should sort them according to their size, into three to four classes, as

generally four classes of tubers are obtained. The first-class should contain the largest tubers; medium-sized tubers belong to the second-class; and the smaller ones to the third; and the wounded, sickly and tubers of coarse shape are included in the fourth-class. The first and second-class tubers are fit for table use. Potatoes for seeds should be selected from the second and the third-class tubers. The fourth class tubers should not be stored but sold out immediately after harvesting, as they will occupy a considerable part of your godown and will scarcely bring gain. These may, however, be stored separately and preserved for family consumption in case no market is available. The diseased tubers should, under no circumstances, be allowed to remain in your godown and they should be picked out immediately after harvesting.

Storing:—If possible, potatoes should be stored on platforms made of bamboo or wood-planks over a layer of dry sand. They should be placed separately but closely. A small quantity of sand should be sprinkled over all the tubers. This is the best method of storing potatoes. On each platform two to three layers of potatoes may be stored, each course having a layer of sand underneath. If it is not possible to store them in the above manner, they should be stacked in heaps on dry-floor over a layer of sand in three to five layers, one above the other. In this case, a thin layer of dry sand should intervene between two layers of potatoes. But potatoes to be preserved for seeds should always be stored in the first method. You should keep a sharp eye on your potato-godowns and inspect them at least thrice a week in order to see if your tubers have rot or caught any disease. When you see that any one of the tubers is so suffering, pick it out and remove it. There should be free access of air and light in the godowns, the tubers will otherwise suffer from rotting and mildews.

Preserving:—Sometimes potato-dealers use Kerosine oil in order to preserve potatoes for long periods. They soak the tubers in Kerosine oil before storing. This certainly destroys the vitality of the tubers and renders them tasteless. This is an objectionable method of preserving potatoes. Others say that if potatoes are washed in a mild solution of sulphuric acid and water, they will keep for a long time in good condition. But in my opinion both these processes are bad as the tubers lose their good taste more or less.

Potatoes may be preserved in good condition for a long time by

rubbing them with wood cinder or washing them in liquid cow-dung. In the latter case, after washing, have the tubers dried in mild heat. This process is less costly and at the same time never interferes with the taste of the tubers. I have experimented these processes with very satisfactory results. They never cause any harm to the vitality of the tubers but rather invigorate them, and keep long them in good and healthy condition.

Seeds:—Bad seeds cause gradual degeneration of the tubers, while good and healthy seeds give birth to new and improved varieties. As for instance, Ambala and Nainital potatoes are allied species and must have sprung from the same origin. Such is the case with Patna and Rungpur varieties, which are nearly the same in size and shape but differ in taste only in some respect. This sort of evolution and degeneration chiefly depend upon seeds, soil and climate of the localities.

I was successful in raising plants from real seeds. I tried them in my experimental-farm sometime ago, with very unsatisfactory results. Most of my readers will perhaps laugh when I say that potato has seeds. These seeds, however, do not suit the Indian soil. In Europe and America many seeds-men deal in potato-seeds. These seeds are extracted probably from tubers by scientific process. They can not do well in this country, as they generally lose much of their vitality in transmission. It is very difficult to raise plants from these seeds. I, therefore, advise my readers not to purchase them. They are sure to be duped by high-sounding advertisements often appearing in newspapers. I was a sufferer on more than one occasion.

It is therefore advisable to use healthy tubers for seeds. Potatoes preserved for seeds in lower Bengal are inferior to those in the hills or places where they are indigenous. Moreover, seed-potatoes preserved in the plains gradually cause degeneration of the tubers in size and shape. It is very difficult to preserve seed-potatoes in Bengal, where excessive rainfall and burning heat of summer, cause immense injuries to the tubers. One of the easiest way by which seed-potatoes can be preserved in the plains is to dry the tubers in mild-heat for a week and then to store them as stated before, for future use. This will, perhaps, serve the purpose, but will not give satisfactory outturn. In order to testify the truth of this, I advise you to get your supply from Nainital and to cultivate the same in your field and to preserve potatoes for seeds from your produce for the ensuing

year. That year you will get tubers of deformed shape and smaller size. During the succeeding years you will gradually get poorer out-turns and the worst tubers if you continue to preserve potatoes for seeds from your produce. Lastly, it will appear like a new degenerated variety altogether losing its shape, size, taste and quality.

Fifteen years ago, no body in this district knew what Nainital, Ambala, Cheerapunji and other varieties of potatoes were. But by continual experiments during these years, I have been in a position to show them what they are and how they should be cultivated here. Now I am fortunate to see many of my countrymen setting apart at least a few cottas of land for potato cultivation. They now grow the quantities they require for domestic use. Even the local cultivators have now taken up in earnest the cultivation of potatoes as an important crop and they most willingly follow my advice and example.

Potatoes for Exhibition

As soon as your crop is harvested, select out of your stock the best and the biggest tubers of good shape for exhibition to any industrial or agricultural fair. By doing this you may be amply rewarded for your labour. Besides you will be regarded as a potato-grower of name and fame, which again will bring great demands for your potatoes from all parts of your country.

During the third year of my experiment with the potato crops, I was known to be the only potato-grower here of some reputation. I have already told you that I was not successful in growing this crop, and that later on my tubers sometimes weighed about a pound each. Some of these tubers were sent by me to the Tangail Industrial and Agricultural Exhibition. They were so very big that a special medal was awarded to me for their unusual size. Since that time, the demands for my potatoes were so great that I could hardly meet them. I used to get orders from many of the well-to-do men of my country, and especially from the European gentlemen, who were pleased to visit my farm.

Market for Potatoes

If you get a favourable market after you have finished harvesting, never allow it to slip away and wait for a next chance, which may or may not come. Potatoes are perishable and in case they are subjected to contagious diseases, they may be destroyed in no time. All your hopes will then be gone once for all. No doubt, if you can preserve your potatoes in good condition till the rains,

they may fetch you a better profit, as price of vegetables then generally goes up very high.

During dry weather, price of potatoes falls down, owing to extensive import. At that time they may be had even at Re. 1 per maund. While during the rains potato-market rises up to Rs. 5 to Rs. 7-8 per maund. But you should never depend upon future. which may come with good or bad results.

Cost and Out-turn

Now I will conclude this article after showing you the probable cost and out-turn per Bigha of land with and without manure. When I started as a beginner, I made my experiments without any manure. In that case, my out-turn was 30 maunds per Bigha, and my profit was Rs. 11-8 only, after deducting the cost of cultivation and rent, as will appear from the table annexed below :—

Table I.—Showing the Cost and Out-turn per Bigha without manure

[A Bigha is equal to a little more than ⅓ of an acre]

	Rs.	As.
1. Digging	2	8
2. Ploughing	3	0
3. Preparing land	2	0
4. Rent	2	0
5. Planting, etc.	5	0
6. Seed Potatoes, 3 maunds	21	0
7. Watering	10	0
8. Harvesting	3	0
Total cost per Bigha	48	8
Produce 30 Mds. at Rs. 2 per Md.	60	0
Net profit	11	8

Table II.—Showing the Cost and out-turn per Bigha with cow-dung manure only

	Rs.	As.
1. Digging	2	8
2. Ploughing	3	0
3. Preparing land	2	0
4. Rent	2	0
5. Planting, etc.	5	0
6. Seeds, three maunds	21	0
7. Manuring with cow-dung (well rotten)	10	0
8. Watering	10	0
9. Harvesting	3	0
Total cost per Bigha	58	8
Produce 50 maunds sold at Rs. 2 per maund	100	0
Net Profit	41	8

My later experiments with the Nainital, Ambala, Patna, Rungpur, and Cheerapunji varieties met with great success. The Nainital and the Patna proved more successful than the others. My out-turn was about 100 maunds per bigha. I sold them at Rs. 2 per maund, immediately after harvesting. The total sale-proceeds was Rs. 200 per bigha. The total cost of cultivation was Rs. 112 as will appear from Table III. My net profit was Rs. 88 per bigha. Besides, I had a second crop of jute on the same land by rotation. That also gave me an additional income. On potato land, jute can be grown with much advantage and success. I now show, by tables

Nos. III and IV a detailed account of cost and out-turn per bigha on a more improved mode of cultivation. They will tell you how you can obtain a better out-turn than that obtained from the same piece of land in the ordinary way, depending simply upon nature.

Table No. III, Recipe No. I.

	Rs.	As.
1. Ground rent for one year	2	0
2. Seed-potatoes 4 maunds at Rs. 7 per maund	28	0
3. Hoeing	2	8
4. Ploughing	3	0
5. Manuring :—		
(a) Castor cakes 10 maunds at Rs. 2-8 per maund	25	0
(b) Cow-dung, well rotten, 90 Mds. at 10 Mds. per Rupee	9	0
(c) Wood-ashes 30 Mds at 10 Mds. per Rupee	3	0
(d) Charcoal-dust 20 Mds. at 10 Mds. per Rupee	2	0
(e) Vegetable manure 10 Mds. at 1 Md. per Rupee	10	0
Total	84	8
6. Preparing land, such as, mixing manures with the soil, levelling and picking out hard substance, etc.	2	0
7. Planting and earthing up	5	0
8. Irrigating	10	0
9. After treatment, such as, weeding and killing injurious insects	2	8
10. Harvesting	3	0
11. Sorting and storing	5	0
Total cost of cultivation	112	0
Total out-turn 100 Mds., sold at Rs. 2 per Md.	200	0
Net profit per bigha Rs.	88	0

Table IV, Recipe II.

	Rs.	As.
1. Ground-rent for one year	2	0
2. Seed potatoes 4 Mds. at Rs. 7 per Md.	28	0
3. Hoeing	2	8
4. Ploughing	3	0
5. Manuring —		
(a) Old stable refuse 50 Mds. at 10 Mds. per Rupee	5	0
(b) Castor-cakes 10 Mds. at Rs. 2-8 per Md.	25	0
(c) Wood-ashes 30 Mds. at 10 Mds. per Rupee	3	0
(d) Charcoal-dust 20 Mds. at 10 Mds per Rupee	2	0
Total	70	8
6. Preparing land as shown in Table III	2	0
7. Planting and earthing up	5	0
8. Irrigating	10	0
9. After treatment, as shown in Table III	2	8
10. Harvesting	3	0
11. Sorting and storing	5	0
Total cost of cultivation	98	0
Total out-turn 75 Mds. sold at Rs. 2 per Md. Rs.	150	0
Net profit per Bigha	52	0

N.B.—Better out-turn may be had if vegetable-manure is added to the above.

Table V, Recipe No. III.

	Rs.	As.
1. Ground rent for one year	2	0
2. Seed-potatoes 4 Mds. at Rs. 7 per Md.	28	0
3. Hoeing	2	8
4. Ploughing	3	0
5. Manuring :—		
(a) Castor-cakes 10 Mds. at Rs. 2-8 per Md.	25	0
(b) Cow-shed refuse 75 Mds. at 7½ Mds. per Rupee	10	0
(c) Wood-ashes 30 Mds. at 10 Mds. per Rupee	3	0
(d) Charcoal-dust 20 Mds. at 10 Mds. per Rupee		

	Rs.	As.
(e) Vegetable manure 20 Mds. at 1 Md. per Rupee	20	0
Total	95	8
6. Preparing land as shown in Table III	2	0
7. Planting and earthing up	5	0
8. Irrigating	10	0
9. After treatment, as shewn in Table III	2	8
10. Harvesting	3	0
11. Sorting and storing	5	0
Total cost of cultivation	123	0
Total out-turn 115 Mds. sold at Rs. 2 per Md. Rs.	230	0
Net profit per Bigha Rs.	107	0

Table VI, Recipe No. IV.

	Rs.	As.
1. Ground rent for one year	2	0
2. Seed-potatoes 4 Mds. at Rs. 7 per Md.	28	0
3. Hoeing	2	8
4. Ploughing	3	0
5. Manuring :—		
(a) Cow-dung. well rotten, 75 Mds.	7	8
(b) Bone-meal 3 Mds.	9	0
(c) Ashes and charcoal-dust 50 Mds.	5	0
6. Preparing land as shown in Table III	2	0
7. Planting and earthing up	5	0
8. Irrigating	10	0
9. After treatment, as shewn in Table III.	2	8
10. Harvesting	3	0
11. Sorting and storing	5	0
Total cost of cultivation	84	8
Total out-turn 75 Mds., sold at Rs. 2 per Md. Rs.	150	0
Net profit per Bigha	66	8

N. B.—The cost of cultivation, shown in these tables, is calculated on the local rates. Where labour and manures are cheaper, the cost of cultivation must be less.

I obtained comparatively better out-turn at a less cost by allowing my cattle to be kept in a cow-shed in the field, as I have stated before. Besides by using "pana" along with the manures noted in recipe No. VI, I obtained nearly the same profit as shown in Table No. III.

By the most improved and scientific methods the outturn may be raised to 150 to 200 mds. per bigha. But that is hardly possible for the ordinary cultivators. Sometime ago, I read a report on potato-cultivation from which it appeared that an European grower got about 215 mds. per bigha by scientific mode of cultivation. Potatoes though native of foreign countries, have been acclimatized almost in all soils over the globe and it hardly requires any further discussion to give you an idea of the same.

LIST OF THE PRINCIPAL VARIETIES OF POTATO

Indian

1. Nainital. 2. Ambala. 3. Patna. 4. Amargachi. 5. Cheerapunji. 6. Rungpur, and others degenerated varieties of less importance.

European

1. Bohemian Pearl, 2. Carltoman, 3. Charles Fidler, 4. Denleigh Castle, 5. Ever good, 6. General Buller, 7. Hearts of Oak,

8. King Edward VII, 9. Northern Star, 10. Sir John Leyliyn, 11. The Bovee, 12. The Sardar, 13. Canell's Come to Stay, 14. Early Regent, 15. Improved Early Ashleaf, 16. Early Puritan, 17. Pride of Tonbridge, 18. Victor, 19. White Beauty of Hebron, 20. Progress, 21. School Master, 22. Supreme. 23. Windsor Castle, 24. Abundance, 25. British Queen, 26. Canell's Victory, 27. General Roberts, 28. Snow Drop, 29. Beauty of Hebron, 30. Flower Ball, 31. Early American Rose, 32. Red Elephant, 33. White Elephant, 34. Bruse, 35. *Magnum Bonum*, 36. Main Crop, 37. Reading Grant, 38. Up-to-date, 39. *Imperator*, 40. Gold Finder, 41. Ring Leader, 42. Boston Queen, 43. Harbinger, 44. Perfection, 45. Prize Taker, 46. Snow Ball, 47. Veitchie's Main Crop, 48. Morning Bar, 49. English Beauty, 50. Gentlemen, 51. Satisfaction, 52. *Alpha*, 53. Britania, 54. Bountiful.

Messrs. H. Canell and Sons of Swanby in Kent; Messrs. Suttons & Sons, Reading, London; Messrs. Veitch & Sons of Chalsea; Messrs. William Paul & Sons of Waltham Cross England & Messrs. Dobbie & Co. of Rathsay, Scotland, possess the largest stock of the above potatoes.

American

55. Early Rose, 56. Early Sunrise, 57. Early Northern, 58. Early Ohio, 59. Pride of the South or Early Bermuda, 60. Early Snow Flake, 61. Crown Jewel, 62. Freeman, 63. Mammoth Pearl, 64. Irish Cobbler, 65. White Star, 66. Green Mountain.

Messrs. R. Binsts & Co., of Philadelphia, U. S., America, have the largest stock of the above potatoes.

New Zealand

67. Ideal, 68. Dean, 69. The Balfour, 70. Northern Star.

Messrs Nimms and Blair of Dunedin, New Zealand, have the largest stock of these potatoes.

Besides the above there are about 100 more varieties which deserve no place in the above list. The names of the best varieties only are included in it. If any one is fortunate enough to import the above potatoes directly from the farms noted above, he will not waste his money by so doing as each of the above varieties is superior in shape, size, quality and taste to all the Indian varieties. I can also undertake to supply the same if I receive order at least four months before the sowing time. Rates to be settled on application. Some of the European and almost all of the American and New Zealand varieties may be grown in the tropical and sub-tropical countries. For fear of the article being too lengthy, I refrain from embodying the description of the

different varieties of potatoes included in the above list. Full particulars regarding them may, however, be obtained from me on application.

ISWAR CHANDRA GUHO,
Jamalpore, Mymensing, Bengal.

DEWAN RAGHOO NATH RAO ON POTATO-GROWING

Dewan Raghoo Nath Rao makes the following suggestions, which, if followed, he thinks, would give a larger yield than the ordinary method :—

In the middle of November, the site for a potato-field should be deeply ploughed up more than once and exposed to sun and air; this should be done after burning the roots and stalks of the crops harvested or allowed them to rot or char them. (2) Planting should commence in the early part of January. (3) A loose, light and friable sandy loam is most suitable. (4) The manure should be mixed with the soil, where each tuber is planted, the manure being dessicated cow-dung mixed with a small quantity of slaked lime. (5) The field should be divided into oblong size of, say 6 feet, by 12 feet. From each point of 6 feet, trenches should be dug a foot and half wide, and from 4 to 6 inches deep which should run length-wise. Then these should be connected by digging trenches cross-wise, a foot apart. (6) Take a flat pan or box, fill it with a compost of leaf mould, coarse sand and garden soil and, pressing it gently but firmly, sow seeds thinly. Then covering the seeds with a thin layer of light soil, keep the pan in a dark room until the seeds germinate. Water it when necessary. (7) As soon as the plants appear above soil, remove the pan and place it in air and light. (8) When the plants are about three inches high, plant them in beds above described as soon as the rains are over. Plant by instalments, at an interval of a week or 10 days, entire tubers. (9) The tubers should be carefully spread on the floor of a room, dry, but doors closed. It would be well to lay a layer of sand and arrange potatoes so that they may not touch each other and then another layer of sand on them. Within 8 or 10 days, they are most likely to sprout out and ready for planting on the ridges. (10) Before planting stir up the soil of the holes and mix it with a handful of prepared manure. Plant deeply, don't water the plots until plants appear above ground which they do within the course of a week or 10 days, failing which they should have one watering. If there is moisture in the soil, water is seldom needed.

Hard water should be softened by exposure before watering the plots. On a dry and high land, water should be supplied once a week. (11) The haulms should be properly earthed up by patting the soil when the soil is not too moist or too dry. While earthing up remove all under-growths and loosen the hard clods of earth with care. Five or six earth-cups are quite sufficient. (12) About the middle of the growth of the crop, top-dressing may be necessary with liquid manure and nitrate of potash. This should be done when the plants have matured. Watering should go on till the plants show signs of decay, that is, when the leaves become yellow. (13) As soon as the vines die, the tubers should be dug out. Before digging up, pull up the stalks for fodder. Harvesting should take place in clear days. (14) Then wash the potatoes well and spread them out on the ground for a few hours to dry. (15) Plots should be changed annually or once in two years and then burn the land after deeply ploughing it. Soot may be substituted for any manure. Keep a bagful of moist soot at the head of the main trench through which water passes. Keep the best and medium-sized tubers for planting next season. Long and half ripened tubers should be reserved as seed. (16) Wash the food potato with a solution of not more than two parts of Sulphuric Acid and 98 parts of water. Immerse them in it for 12 hours, the thick skinned varieties should be kept longer in stronger solution. The cost for ploughing, seed, planting, manuring, watering, harvesting, watching, assessment, etc., would be about Rs. 40. The value of the general out-turn would be double this amount about 80 maunds or Rs. 80.

INDIAN POTATOES FOR LONDON

An interesting account is given in an editorial note in the Pusa "Journal of Agriculture," on this subject. The experiment was successfully undertaken a few years ago by Mr. Coventry, the present Principal at Pusa, and was only abandoned because the lands at his disposal proved unsuitable for the continued growth of the tuber which became diseased. The main point was that young potatoes should reach the London market at a time when there are none forthcoming from any other source. Several tons were despatched at a cost of less than 1*d.* per lb., and realized 2*d.* a lb., wholesale to be retailed at prices which sometimes rose to 1s. a lb. in the

West-end of London, where they were sold as a delicacy. Although the climate of Bengal is not favourable for potatoes, the same cannot be said of the Upper Provinces. Fifty years ago, however, the tuber was hardly grown in any locality in the plains by native cultivators, except in the neighbourhood of Farrakhabad. There the Kachis, an intelligent market gardener caste, purchasing the town-manure from the city-sweepers for an amount which was proved to be between Rs. 60,000 and 70,000 annually, put about 1,200 acres every year under potatoes between, it is somewhat marvellous to relate, a crop of maze and tobacco. Although in many cases it was "against caste" to eat the potato, yet gradually its virtues became appreciated and 'Farrakhabad potatoes' could be bought in every bazar in the Doab and are now eaten by every caste. In later years potato-cultivation was extended under English guidance to the Himalayas, and now fresh seed, free from disease, is annually exported from Nainital and elsewhere in August and September to be sown in the plains in October. Thus, it only requires an extension of the export system on Mr. Coventry's plan to promote potato-cultivation into one of the most profitable industries in the Upper Provinces.

CULTIVATION OF SEED POTATOES

In regard to the attempt to improve the stock of seed-potatoes, the Collector of the Nilgiris in a letter to Government says:—

"It appears that the Curator has been importing from England good seed-potatoes year after year for sale to the public, but people do not readily come forward to purchase them on the ground that the cost of the seeds so imported is much higher than those available in the local market. It is, therefore, undesirable to continue on these lines. Good seeds may be imported from England, and sown in the gardens under the supervision of the Curator. The crop may be sold for seed purposes to the public at local rates. If the crop of seed-potatoes is superior to the local supply, there will be no difficulty in disposing of it: if it is not superior, the attempt must be discontinued." Government have in an order just issued approved the Collector's proposals.

COMPARATIVE RESULTS WITH DIFFERENT VARIETIES

Experiments made at the Burdwan Experimental Farm in potato cultivation, to test the productiveness of Bengal against

Punjab and United Provinces varieties, have given some interesting results. These Bengal varieties (Patna, Bettiah and Colgong) were planted at the rate of 720 lbs. per acre ; the United Provinces variety (Farukhabad) also at the same rate, and the Punjab variety (Umballa) at the rate of 1,800 lbs. per acre. Of the Bengal varieties Patna gave an outturn of 21,156 lbs. per acre at a total cost of Rs. 233-10-0 per acre, and a profit of Rs. 82-3-0 per acre on the money value of the out-turn. The other two Bengal kinds were cultivated at a loss of Rs. 84 and Rs. 98-13. The Farukhabad (United Provinces) variety gave an out-turn of 19,680 lbs. at a cost of Rs. 220-14 and a profit of Rs. 19-2-0. The Umballa (Punjab) potato yielded 20,496 lbs. at a cost of Rs. 318-3 and a profit of Rs. 25-8. Bengal, therefore, had the first place among the three successful varieties, though was "run" rather close by the Farukhabad potato. The Umballa tuber is much larger than the others experimented with and its out-turn and profit were also satisfactory.

POTATO-PESTS

[Reference: Dr. Watt's Dictionary of Economic Products, Vol. VI., Pt. III., S. 2330; The Agricultural Ledger, 1903—No. 4]

The ignorance of the origin and nature of the potato-disease and the absence of any serious effort to check it, is responsible for the many instances of poor-quality crops. Simple peasant-folk of India attribute the year's bad crops either to weather or to ill-luck. Experiments have been made which show that these diseases are capable of treatment with the result of minimising the amount of yearly damage. Among the very many enemies of potato, two might be mentioned. In the damp and humid climates of lower Bengal and Assam, the deadly *Phytophthora Infestus de Bary* causes yearly havoc to the crop, while in the dry and sultry climates of Upper India, the so-called "*Bangle Blight*" takes its place and is looked upon with but little less apprehension by the cultivators. To successfully ward these two pests off practically spells for the crop, its general safety and health.

Phytophthora Infestus

Identification :—The plants droop and bear but small tubers. In some cases, the leaves turn black and fall off very rapidly,

leaving green-stalks absolutely bare in a week or so, while in others, both leaves and salks fall over together in a rotten pulp. Sometimes the leaves only contract and have dry patches and look absolutely deformed. The disease is first detected by the appearance of small brown-spots on the leaves which increase in size and spread throughout the plantation with surprising rapidity. The tubers have black patehes and begin to rot giving off peculiarly strong bad odour, making them totally unfit for human consumption. The whole crop is thus wasted. It is known as *Dhasa*, *Marka*, *Pokadhara* or *Marmaria* among the villagers of Bengal.

Treatment :—No method of actually curing the disease has yet been discovered. In this instance also, prevention is better than cure. Care should be taken not to use as seeds, tubers containing living germs of the fungus. Tubers from distriets known to have suffered from an attack last season should be religiously avoided. Small tubers, which are set whole, are liable to contain the germ, as one of the effeets of the disease is to stun the growth of the tubers. It is safer, therefore, to use eut-sets as seeds and reject the ones that have been blackened by disease. *M. Jensen* of Copenhagen suggests a method of sterilizing the suspected tuber by plunging them for 4 or 5 hours in water at temp. 104° to 120° F., by whieh, it is claimed, the fungus is successfully destroyed, while the germination of the seed is left quite unimpaired. To insure the success of this process, however, care must be taken that in all the neighbouring plantations the seed-tubers are similarly sterilised, for the spores of the fungi reared in and blown from the untreated field, will likely cause the experiment to fail. A process, with a fairer prospect of success, and recommended by *M. Prillieux*, is the spraying of the crop with Bordeaux Mixture by which, not only is the spread of the disease effectively checked, but the yield of the crop is, owing to some unknown and unaccounted reason, considerably increased, thus, more than covering the extra expense incurred by its adoption. To prepare 50 gallons of the mixture, take 6 lbs. of Sulphate of Copper (তুঁতে) and dissolve it in 25 gallons of cold water. Metal vessels should never be used to make this solution. Gradually slake 4 lbs. of fresh quick-lime into powder and add 25 gallons of water. When cool, mix the two solutions with constant vigourous stirring and the mixture allowed to stand. Should the mixture appear to contain copper, more lime should be added. The easiest test for exeess of eopper is to plunge a piece of iron in the mixture and

to see if a coating of copper appears on it. The mixture is then sprayed thoroughly with a syringe, twice just before and once as soon as the first signs of the disease have appeared. About 150 gallons of the mixture is sufficient for spraying an acre.

It may be noted here that general health and sanitation of the plant goes a long way. The healthier the plant, the more will it be able to resist the attack of pests. Too much care cannot, therefore, be taken with regard to administration of proper manure to the soil, its fastidious preparation, changing of the varieties constantly, and prevention of excessive irrigation by extensive system of drainage.

The "Bangle" Blight

Identification :— A plant which is quite healthy, one day suddenly begins to fade the next and quickly droops to death. The tubers are arrested in their growth. The disease appears only when the crop is nearly matured. One redeeming feature of this disease is that, unlike *Phytophthora* which attacks and spreads from field to field, it keeps itself confined to individual plants.

Treatment :—As preventives of the disease, (*a*) frequent changes of variety, (*b*) removal and destruction of stalks of the previous year from diseased fields, (*c*) burning of the infected soil before cultivation, followed by manuring, (*d*) resting the field occasionally for a season or two from potato and (*e*) growing the sets on ridges may be profitably adopted. Sulphate of Copper Solution may be used for irrigation in order to destroy the germs in the soil.

Other Diseases

There are other potato-diseases in India—such as, the "*Karrah*" a leaf-disease in Oudh, the "*Early Blight*" also a leaf disease appearing in the earlier stage of the crop (as opposed to the "Bangle Blight,") in the United Provinces, and the root-blight caused by the *Pythium* —which also do tremendous damage to the crop. Their distribution, luckily, is not nearly so extensive as the two mentioned before and their treatment is neither very different from them.

P. R. C.

Alfalfa

AN AMERICAN FODDER SPECIALLY SUITED TO INDIAN SOIL AND CLIMATE

The question of fodder and how to get a plentiful supply of it, is one of the most paramount importance to India. From that land of great scientific agricultural experiments and of great agricultural achievements—the United States of America—we learn that quite a revolution has

been caused in the agricultural world there by the quiet introduction of the new forage plant Alfalfa. The plant was introduced into California about fifty years ago, and for a time its culture was mainly confined to that State, but it has recently been found to thrive throughout the whole mid-continent, and has nowhere in all that region proved a failure. Its original home seems to have been Central Asia. The Greeks and Romans knew it two thousand years ago. The Romans cultivated it as a forage plant, and carried it with them in their African campaigns.

Alfalfa was first introduced into Mexico by the Spaniards, and when it came under the investigations of the Government Agricultural Stations in the United States, the plant was thought to be a South American one. It seems to possess just those qualities which vast agricultural tracts of territory in India urgently require. It is a drought-resister and feeds so deeply that only the most protracted dry weather can possibly have any effect upon it. It feeds from ten to fifteen feet down into the most compact of soils, and is said to have a capacity of going even fifty feet into loose soils. The young plant consists of a number of low branches, springing from a simple stalk at the crown of the roots. On the old plant the robust stems will grow underground and become new plants. That is, the plant has the power to multiply itself by side-growth.

It will grow in any soil from the sea level to seven thousand feet elevation. It adapts itself to lime-stone, but prefers a light and sandy loam with a loose sub-soil. The one demand it makes is for good drainage, and hence there are considerable districts in Bengal where Alfalfa, or lucerne, as it is also called, would not flourish. Water must not be allowed to stand on a field of this fodder-plant for more than forty-eight hours, for if the ground becomes saturated and remains so for any length of time, the roots will decay. On suitable land rich in lime and potash where the sub-soil is drained, the plant becomes permanent, resists droughts of the severest nature, and yields three crops a year without failure. Like clover, alfalfa is a nitrogen collector, and by growing it, the ryot would not only secure large quantities of excellent hay or fodder but he would at the same time enrich his fields instead of exhausting them. If the crop is ploughed under it supplies a vast amount of nitrogen to the soil.

Alfalfa yields considerably more than double the average hay crop. The amount of hay that can be cut per acre from the new plant is

from four to six tons—from three successive cuttings. In some of the Southern States of the Union, seven cuttings have been taken during the year. On one field in Mexico, which has been under alfalfa continuously for over sixty years, the plants are said to be in as good condition to-day as ever they were. The hay from alfalfa is worth as much, weight for weight, as any other kind of hay, and it is suitable for all farm animals. The most profitable plan is to use the hay and fodder as rations—not to turn the animals in amongst the pasturage. The United States Department of Agriculture reports that a single acre of alfalfa will furnish forage for twenty hogs, throughout the season.

The Department of Agriculture of the United States will be glad to supply all the necessary information which the authorities in India, or others interested, may desire regarding alfalfa and its cultivation, and from the same quarter also, a plentiful supply of seed may be obtained.

ADDRESS FOR PROCURING ALFALFA SEED

The following extract of a letter from Mr. W. J. Spillman, *Agrostologist*, of the United States Department of Agriculture, Bureau of Plant Industry, might be of some interest to the public :—

"Your letter just come to hand, and I take pleasure in forwarding you one pound of alfalfa-seed, through our despatch agent, Mr. I. P. Roosa, Post Office Building, New York. We are also sending under separate cover some of our recent literature on the subject of alfalfa, which I hope will be of interest.

"In case, you should wish to purchase a larger quantity of seed, you can probably obtain it from J. M. Thorburn & Co., New York City. The catalogue price is 20 c. a pound. If you prefer seed from the South or West, you might obtain it from Messrs R. E. Smith, Sherman, Texas, or from the Germain Seed Co., 326 South Main Street, Los Angeles, California. It is desirable to have seed from similar climatic conditions to that where it is to be used, so far as this may be done."

CITRONELLA AND LEMON GRASS

The Citronella and Lemon Grass-oil industry is assuming considerable importance in Ceylon. It is curious that the subject has not attracted notice in India, where the climate and

other conditions are equally favourable for its development. At the last monthly meeting of the Ceylon Board of Agriculture, Mr. Herbert Wright, Controller of the Experimental Station, Ceylon, read a most instructive paper on the subject, which we reproduce below as it may prove of interest to some of our readers:—

"I have on a previous occasion made some remarks on the subject of Citronella and Lemon Grass in Ceylon, and to-day I propose to say a few words regarding the progress of our experiments with Citronella. In the first place it is pleasant to be able to record the assistance which has been given by Mr. Jowitt of Bandarawela, Mr. R. Jackson, Sita-Eliya and Mr. Thomas in the Central Province; these gentlemen have established plots of Citronella and Lemon Grass at various elevations and our series of co-operative experiments being now complete, we may hope to obtain reliable information on the growth of these grasses from 2,000 feet at Peradeniya, to 7,000 feet or the Hoton Plains.

Satisfactory progress has also been made, through Mr. Holbert in England, in connection with the manufacture of paper from the grass after the oil has been extracted; and also, from the wild maana grass, so common in many parts of the Island. One English firm has reported to the effect that the material is most satisfactory and another firm has asked for sample lots, 3 tons in weight, in order that the experiment may be carried out on a commercial scale. I have recently despatched one ton of the grass, and it is encouraging to know that Messrs. Tarrant & Co., Colombo, are able to bale the material at cheap rates, and that the home-firms are not only willing but anxious to pay for the cost of collecting and baling the grass in large quantities. By the co-operation of firms in Colombo and England, I think we may confidently look forward to an accurate determination of the value of Mafina and Citronella grass for paper-manufacture.

But the most important work, which has been undertaken, is in relation to the yield and value of the unadulterated oil. It will be remembered that from May, 1902, experiments have been carried on at Peradeniya, and we are now in possession of information regarding the methods of cultivation, the yields obtainable at an elevation of 2,000 feet, the physical and chemical properties of the soils suitable for its cultivation, and the botanical and chemical characters of the grass itself. Obviously the one thing required is the selection of the soils suitable for its cultivation, and providing the

London market with a guarantee from Government, that the extraction was absolutely pure. This has been done through the Agency of Messrs. Clark Young and Co., Colombo, and thanks to them, and also to Messrs. C. P. Havley & Co., of Galle, some very valuable reports have been obtained. I do not propose to trouble you with these reports in detail, as the whole of the information is about to be published in the Circulars and Annals of Botany, issued from Peradeniya. Furthermore, great interest has been aroused among London firms and chemists and Messrs Sage and Harrison have already published some of their views on the oils exported from Peradeniya, in the "Chemist and Druggist."

THE SEASONING OF BAMBOOS

Bamboos play a very important part in the life of the Indian people, being an almost never-failing accompaniment to materials for household furniture. To the majority of the people living in Cottages, bamboos have not a little to do with the forming of their thatched or tiled houses. Hence its value is very great. The loss to the people when such an article is made worthless in no time by the beetle is very great indeed. Mr. E. P. Stebbing of the Agricultural Department, has a suggestion to make in order to prevent deterioration in the quality and, what is more, to prolong the life of bamboos. The method has been determined after performing a number of experiments. His recommendation is that in order to protect the bamboos, they should be soaked for five days in water, be allowed to dry for several days in a covered shed and, after drying should be soaked for 48 hours in common Rangoon oil. Bamboos treated in this manner were used for the field telegraph posts in the Tibet Mission and remained unattacked. As the result of the experiments and observations made, it may be taken that the oil-treatment prolongs the effective life of the bamboo by at least 2½ years, which, considering how largely bamboos are used in India, means, by the prolongation of their usefulness, a large monetary saving. The bamboo-beetle known also as the shot-bearer works mischief in three ways. The female bores into the bamboo and lays its eggs there; the grubs hatched out of the eggs eat into the soft-wood inside the bamboo; the fully matured beetles then bore out their way into open air. In the course of a year the insect is said to pass through five, if not six, generations. The enormity of the loss

done by it may easily be imagined.
—"Advocate"

ELEPHANT GRASS AS A FOOD SOURCE

The report goes that in Baluchistan the pollens of the flowers of a kind of grass called 'Elephant' grass are being used as food. They make *roti* (bread) just as good as of flour which is much in use among the people of Bombay and Sind-side of the Country. The eye of Government has recently been attracted to this.

CASSAVA

For years past endeavours have been made to popularise the cultivation of the Cassava plant in this country. The Bengal Agricultural Department has attempted the task of showing by actual cultivation at the Sibpur Farm (opposite Calcutta on the Hugly) the value of this plant, not only as a profitable crop, but as a stand-by during periods of drought and scarcity; but so far as we are aware, all attempts to induce the Indian cultivator to take up the Cassava as a regular crop, have failed everywhere in India. It is at present grown in several parts of India, Burma, Assam and Ceylon mostly in gardens and not as a regular field-crop.

All the information available on the subject has now been collated and embodied in an 'Agricultural Ledger' (No. 10 of 1904) by Mr. I. H. Burkill, Officiating Reporter on Economic Products to the Government of India, recently issued. Mr. Burkill shows that the plant is of American origin. There are two distinct kinds, one with poisonous roots, the other non-poisonous, called Sweet Cassava; but there are a great many varieties between 40 and 50 according to some authorities. In this country we have what Mr. Burkill calls several 'races' introduced at various periods by Portugese settlers and others. These do not show any particular fancy for soil or climate moisture or drought. They are found growing vigorously in moist Bengal, in the arid wastes of the Punjab and Rajputana, in the cool valleys of the Himalyas and the salubrious slopes of the Western Ghats, all along the Coromandel Coast and the west-coast right up to Goa, in Assam and in fact everywhere.

Like its near relation, the Ceara Rubber tree, it is equally vigorous on the plains of India upto an elevation of 7000 ft. above the sea level. These being the conditions under which the plant

grows, it is somewhat surprising that it has not been adopted as a field-crop in this country, especially when we consider that it does not require any particular cultivation. Indeed, when we say "cultivation," we refer to the word in its true sense. As a matter of fact, cuttings put down in any light soil, or sandy soil, will strike readily, and grow vigorously. There is only one condition that the plant demands, *viz.*, a light soil. Heavy clay soils do not suit it so well, though it will grow in it, but the development of the roots will not be so good.

Mr. Burkill tells us that the "sweet cassava" is hardier than the other, which we may call the "bitter," but the tubers are smaller and yield a smaller quantity of starch, which is stored up in the roots, and is guarded with more or less Prussic Acid. The greater part of the poisonous element may be only in the bark of the root, and the interior be perfectly sweet and harmless; or the Prussic Acid may occur all through the root, in which case it must be eliminated by heat before it is fit for human consumption. What we call Tapioca is made from the "bitter" cassava, after the poison has been driven off by heat. There are degrees of poisonousness. The most poisonous roots appear to be those with yellow-fleshed and rather fibrous tubers. Death is very rapid after the poisonous root has been eaten; but the peculiar bitter flavour of the poisonous variety should warn any one of its danger. Until quite recently the "sweet cassava" was not thought to be quite harmless but analysis has proved the reverse.

COFFEE IN MYSORE

The Mysore Agricultural Department is giving much attention to the improvement of coffee cultivation, the principal crop of the State. Investigation has been made into the soils, methods of cultivation, manuring and the like; suggestions have been made for improvement but it is said that without a coffee experiment station it is difficult to make proper tests. In the State Laboratory efforts have been made to discover a test for quality in coffee which seems to bear a close relation to the specific-gravity. The work which is being done in Mysore in connection with coffee, ought to turn out, of considerable importance, not only to the State but to the coffee industry of Southern India generally.

Wheat

PROPOSED CLASSIFICATION IN BOMBAY

The Bombay Agricultural Department are about to publish a botanical classification of Indian wheats by the Economic Botanist to the Provincial Government. In the Bombay Presidency wheat is not so important a crop as cotton, occupying only some 2 million acres against over 5 million acres devoted to cotton. The Bombay wheats vary very greatly not only in commercial value but also in their suitability to different conditions of climate and soil. Numerous varieties are now being grown on all Government Experimental Farms in the Western Presidency to ascertain whether any variety, superior to the indigenous varieties, is equally suitable to the local conditions of soil and climate. At the same time selection of seed is in progress and experiments in hybridization are being conducted with a view both to improve the quality and obtain a rust-proof variety.

IMPROVEMENT OF INDIAN WHEAT

The scheme suggested by the Board of Agriculture for future work on the improvement of Indian wheats embraces the following measures:—(1) the agricultural survey of the wheats in each Province; (2) milling and baking tests; (3) uniformity of sample; (4) rotation experiments; (5) adulteration; (6) storage; (7) transport difficulties; (8) experimental work on the improvement of Indian wheats. With regard to the second, it has been suggested that the co-operation of the Incorporated National Association of British and Irish Millers should be secured to carry out tests to determine the milling and baking characters of Indian wheat.

Experiments in the improvement of wheat cultivation are now pretty general in all the wheat-producing provinces of the country. They are being conducted on Experimental Farms in the Punjab, the United Provinces, the Central Provinces, Bombay and Bengal and are all of the same general character, the varietal-selection (both regards yield and rust-resisting power), hybridization and manurial experiments being chiefly prominent. Australian varieties have been largely tested at all farms, but so far, the introduction of exotic varieties has not, it is said, been very successful, though an exception is made in

the case of an Australian variety at the Lyallpur Farm in the Punjab. In other directions the results have been more encouraging; a hybrid has been produced in the Central Provinces which has been found to be the most rust-resistant and seed is distributed to cultivators every year through the agricultural associations. In Bengal, Muzaffarnagar wheat has given encouraging results. Seed-distribution is being carried out in the Central Provinces, Bengal and the Punjab, and there is an increasing demand from the cultivations for the seed produce of Government Farms.

A GARDEN OF MEDICINAL PLANTS

One of the prettiest natural growths in San Francisco to-day, and withal the most variegated as to colors, is the mass of brilliant blooms that not only adds to the beauty of Golden Gate Park, but is constituting an experiment of great utilitarian value. It is called the "San Francisco Garden of Medicinal Plants." In this drug-plant garden there are specimens of medical vegetables to the number of 400 and, in time, the plot will contain more than 3,800. That will make it the most complete drug garden in the United States.

It is the view of the officials connected with the drug and medicinal plant investigations of the Department of Agriculture at Washington that California is in the matter of soil and climate peculiarly fitted to the production of these growths, and, while their cultivation at the park is more or less of an experimental nature, there is little doubt that the ultimate result will be to demonstrate the possibility of producing them on a commercial basis.

Unquestionably there is a big market—and a home market too—for medicinal plants. The United States buys abroad each year vegetable drugs of the value of $10,000,000. There is no reason why almost the whole of this money should not be retained in this country. The varied physical conditions of America make it possible to grow within its borders nearly every variety of plant used by the physician and druggist.

It is, because, the Government experts recognize this fact, and because they are busying themselves in the matter of interesting domestic agriculturists in the cultivation of drug plants, that the garden has been established in Golden Gate Park.

Dr. Rodney H. True, who is in charge of the drug and medicinal

plant investigation of the United States Department of Agriculture, suggested to the Golden Gate Park Commissioners the desirableness of establishing the plot here and the Commissioners took up the idea with alacrity. Ten acres of land on the outskirts of the reservation have been devoted to the purposes of the drug garden. The planting was done early last year, and this summer, as stated, the garden is a mass of brilliant bloom.

All the specimens have been raised from seeds or cuttings and each is labelled in a manner showing the natural order or division, the generic title, and specific and common name. The nativity of the plant is also mentioned, and the parts used for medicinal purposes are indicated.

Of the 400 varieties now well-rooted in the garden, hemlock of healing and poisonous qualities, holds an important place; Scotch lovage is a large plant with white flowers, whose roots are used in hysteria. Then there are henbane, to relieve the sleepless; chamomile, to cure dyspepsia; worm-wood, to aid digestion; digitalis, to reduce fever; valerian, to aid people with racked nerves; sun-dew, esteemed for its acridity; marsh-mallow, abounding in mucilage; St. John's wort, an astringent and aromatic, the leaves used as a vermifuge; the red clover, with its alkaline matter and lime, said to possess properties which are curative in cases of cancer; and many others, among which are aconite, belladonna, taraxicum, chicory, hoar-hound, mustard and rosemary.

Additions are being made nearly every day, and interest in the garden is largely shown as evidenced by the numerous letters of inquiry as to what plants are being cultivated. Visitors to the park ask for the garden. Germans in particular delight to watch these plants and herbs which were familiar to them in their own country across the sea, flowering in vigor and beauty here.

Should the valuable experiments being conducted at Golden Gate induce growers of California to undertake the cultivation of drug-plants on a commercial scale, they will find an ample demand for the product.

"There is a great deal of ignorance concerning the value of many plants which grow wild"—says Mr. McLaren, Superintendent of the park,—"and it is partly due to this ignorance that America is sending so many dollars to other countries for medicinal vegetables. Some plants of great value are classed as cumbersome weeds by farmers, who uproot them and throw them out of the land. For instances, golden-seal *(Hydrastis Canadensis L.)* was once so abun-

dant in the East that it was torn up and burned by farmers to keep it from over-running their field. It was considered a pest. But to-day it is worth about 75 cents. a pound wholesale. There are scarcely 150,000 pounds collected annually in this country, and the actual demand is several times this amount.

"Thyme-oil made from the ordinary thyme of the old New England gardens, is imported to the extent of some 40,000 pounds a year. The Department of Agriculture is of opinion that the commercial growing of thyme on a small scale should prove very satisfactory. Snake-root is another easily cultivated medicinal plant, the local production of which does not meet the local demand, and prices are very high in consequence. Dock and dandelion grow wild but the cultivated varieties are so superior that there is profit in growing them."

It is interesting to note that apart from the test-plantation at the park, independent efforts are being made to introduce the cultivation of some drug-plants into California. Among these is the cinchona (Peruvian bark) and the prospects of establishing it here are bright. Extensive and reckless gathering of cascara is causing Californians to consider the advisability of establishing plantations to meet the growing demand for this valuable remedy.—*Alvin*, in FLORISTS' EXCHANGE.

There is a great field in India in the matter of cultivation of drug-plants on a systematised scale and drug-gardens are sure to be as valuable as, if not more than, the fruit and other gardens which are at present, the one outlet for the surplus wealth of our rich men.

In the interests of development of our Ayurvedic Science, serious attention ought to be paid to this subject. The home demand for medicinal plants being inexhaustible, it is certain that any outlay of money in this direction cannot fail to be reproductive, at any rate, by no means less, so than the other ordinary investments, we are accustomed to.

A SALT-FEEDING TREE

Few are aware that "Marakhabaram" (the Flame of the Forest), called in Sanskrit "*palas*," (Plassey being so called on account of the abundance of the tree there) is a salt-feeder. It is called "*dak*" in Northern India. Experiments in reclaiming alkaline land by growing "Buttea frondosa" have been made in Northern India. Jungles

abounding in the tree are plentiful in the Uttankarai Taluq, Salem District. Along the road leading from the Samalpatti Station to Uttankarai, trees of the kind are said to be plentiful. Many who wish to grow the tree on alkaline land have enquired where they could get seed. The District Forest Officer, Salem, could arrange to supply seed if applications were made through the Agricultural Department. The leaves are used for stitching into dish plates. The stem yields a valuable gum known as "Butea kino."

—"M. M."

Paddy

BEST RICE IN THE WORLD

There is some evidence that paddy was introduced into Madagascar from India. From Madagascar the plant was taken to America by the captain of a vessel about the year 1700. Now the Carolina rice is considered to be the best in the world. The grains are big and white and contain a very large portion of fine starch. And these are not the only good points about the North American paddy. The roots go straight down into the sub-soil, and take their food there. On account of its deep roots, the Carolina paddy withstands long periods of drought. Very different is the case with the paddy in India, where a few days of dry-culture will prove fatal to the crop. In this country, paddy requires to be watered at least every second day. The Indian variety has horizontal roots, which spread over the surface of the ground like net-work and ramify. These facts are presented in an interesting circular issued by the Madras Central Agricultural Committee, and indicate that amongst the many agricultural experiments now being made in India, drought-resisting varieties of crops need particular attention.

Sugar

REVIVAL OF '*GUR*' OR SUGAR IN BENGAL

According to the official calculation, about 24 lacs of bighas of land are under sugar-cane in Bengal, out of which some 2 crore 4½ lacs of maunds of *Gur* are produced annually.

Besides sugar-cane, *gur* out of date and palm-juice to the extent of some 43½ lacs of maunds is produced. *Gur* and sugar are articles of daily consumption in the country. So, the trade in these articles is limitless. Our country-

men ought to bestir themselves betimes in this direction before foreign capitalists should secure the mastery of the field.

A. B. Patrika writes :--Like the weaving-industry, the sugar-industry was in a most flourishing condition in this country some thirty years ago, and more than supplied its needs. It is now in a moribund condition. We are glad to announce that the sugar manufactory, established at Tarpur, Kotechandpur P. O., District Jessore, more than a quarter of a century ago, by the enterprising Banker and Zemindar Rai Dhanpat Sing Bahadur, which had to be closed owing to cheap, though sweetless beet-sugar, has resumed work, under the direction and with the capital of his worthy son, Maharaj Bahadur Sing of Azimganj, Murshidabad. Whether it is a fact or not we are not quite sure, but a notion prevails in this country that foreign sugars are cleansed and bleached with bone-charcoal, etc., which are abominations to the Hindus and Mahomedans alike. We are assured that the Tarpur sugar is free from all such impurities and adulterations. The manager is ready to shew the working of the factory to any one interested in the industry. Samples and rates may be had at 37, Canning Street, Calcutta, and particular from the Manager at Tarpur.

THE SUGAR INDUSTRY

Mr. S. Tandurangam writes to the "Madras Mail" from Cuddalore under date, July 20th 1904 :--With reference to Mr. Jordan's letter in your issue of the 10th instant, I think I am bound to give my details of the cost of manufacture from my actual experience. The first seven items of expenditure amounting to Rs. 2-6-0, given by Mr. Jordan, exactly tally with mine for a day of 10 hours. In the 8th item he has put 3 men for finishing pans. But, along with his juice-boiling pan, I had to keep 12 finishing pans to keep the mill continuously working, for which 2 firemen at 3 annas each, 3 mistries at 6 annas each and 3 men to assist them at 3 annas each were required—the total wages of these men amounted to Rs. 3-15. Besides, 3 men for odd jobs at 9 annas, were needed. As detailed by Mr. Jordan, I had no overseer. Thus the total cost of coolies amounted to Rs. 6-14, *i. e.*, Rs. 2 more than Mr. Jordan's estimate. As regards liquid-fuel, etc., for the oil-engine for 10 hours, it would cost only Rs. 2-8, *i. e.*, Rs. 2-10 less than his estimate. Mr. Jordan has omit-

ted an important item of expenditure, namely, fuel for the finishing pans. In addition to dried cane-refuse, I had to use fire-wood which cost me Rs. 3½ per candy of jaggery made, or Rs. 16 per ton. Thus, the total cost of manufacture for a ton of jaggery would come up to Rs. 25-6. Mr. Jordan's mill is a great convenience over the cattle mills, the former doing five times the work of the latter, or the work of 10 pairs of bulls with much less cost. But it becomes difficult to boil all the juice as it is being extracted from the mill, as we require a number of pan for it—12 pans along with one Jordan's pan, or 20 pans without it. These pans are troublesome and cost much for fuel. If Mr. Jordan could find an easier and simpler method of boiling the juice, he would be conferring a great boon on the jaggery manufacturer and be placing him under deep obligation to him.

CANE SUGAR IN MYSORE

Mr. A. E. Jordan of Bangalore writes:—I beg to enclose an extract from Appendix C to the First Annual Report of the Imperial Department of Agriculture for the year 1904-05, written by Dr. Lehmann, the Agricultural Chemist to the Mysore Government:—

The work of the Department is to be confined at present to soils and their crops. Sugar-cane and its manufacture into jaggery "*gur*" and raw centrifugalled sugars have received most attention so far. The sugar-cane of Mysore is of particularly good quality. One sample analysed contained less than $\frac{1}{4}$ per cent. glucose and over $21\frac{1}{2}$ per cent. sucrose, and to find a sucrose-contain of 17, 18 and 19 per cent. is quite common. In fact, if it contains appreciably less than 17 per cent., it is probably not ripe or over ripe. From a refiner's or sugar-maker's standpoint, the extraction and boiling of the sugar-cane-juice are very defective. The extraction is generally between 50 to 70 per cent. of the weight of the cane, and a large percentage of the sugar in the juice is lost by fermentation after milling, and by inversion during boiling, the latter on account of insufficient liming, the former on account of want of cleanliness. In one case, over 13 per cent. of the total cane-sugar in the juice was inverted, and an average of one extensive set of experiments conducted in one of the best sugar boiling districts (Tumkur) indicated that over 7 per cent. of the total sugar extracted from the cane was inverted before or during

the boiling of the juice. Taking that one pound of inverted sugar prevents two pounds of cane-sugar from crystallising, this implies that, if these jaggeries are refined, there is an average loss in the refinable sugar of 21 per cent., and that in the one experiment quoted above there would be a loss of 39 per cent. of the total sugar extracted in the juice. The inversion caused by over-heating, on account of boiling over a direct fire, instead of by steam, seems, if judged by the experiments conducted here, not as great as is generally believed, for, in many cases, where juice was limed to neutrality, no inversion could be detected, though the boiling was done in an open native iron-pan over a direct fire.

On a previous occasion—Mr. Jordan continues—I had to question Dr. Lehmann's statement, in his Fifth Annual Report, which was to the effect that in order to develop the refined sugar industry, it should be the object of the ryots to turn out a better quality of raw-sugar by centrifugalling their jaggery, as was done by him in the laboratory. As it is an actual fact that the white-sugar imported into India is not refined from raw-sugar,—and could not possibly be imported into India from other cane-growing countries if it was,—I think, it is about time that the various Agricultural Departments, and especially their Chemists, awoke to the fact that the cane-sugar industry of this country will never be developed until the same methods are adopted as are employed in other sugar-producing countries, viz., that the white-sugar be manufactured direct from the cane by the employment of the cane-refuse only as fuel, without converting the clear juice into raw-sugar at all, and without the employment of animal-char.

It is easily seen from the extract given above how easy it is to convert the "sucrose" into "glucose" by boiling the juice into jaggery or raw-sugar. Why Dr. Lehmann does not advocate methods by which such conversion or inversion can be avoided, is quite beyond my comprehension and I can only conclude that he does not know of them.

It is all very well for a chemist to take a small quantity of cane-jaggery, extract the molasses from it, by spinning it in the centrifugal machine, then analyse it and find that it has a high percentage of "sucrose" and very little "glucose," and then to dictate to the cultivators what they have to do. Let Dr. Lehmann purchase a few hundred tons of that good quality of raw-sugar, let him put up a Refinery, and endeavour to refine

this raw-sugar, (which during storage in the godowns for six months or so has been converting itself into "glucose,") by purchasing thousands of tons of wood or coal. Let him again put up a Distillery in order to deal with the large quantity of molasses. He will find himself, in a very short time, a ruined man. The manufacture of raw-sugar in a Laboratory, and the refining of it on a large scale, to be commercially successful, are two very different things.

In the same Report, Dr. Leather, the Agricultural Chemist to the Government of India, also advocates the same methods as Dr. Lehmann. I have not taken to writing on the sugar industry without having a special knowledge. I challenge these gentlemen to disprove the statement I now make, *viz.*,—that the employment of the method of manufacturing white-sugar from the sugar-cane as advocated by them, *i.e.*, to convert the cane-juice into jaggery, or even a good quality of raw-sugar, and then refine it, is one of the reasons,—and in my opinion the chief reason,—for the backward state of the cane-sugar industry in India.

Another reason is the encouragement given by the Government of the conversion of the sugar in the cane into spirit by paying higher prices for spirit made from cane-jaggery. I have drawn the attention of the Excise Committee now making investigations about this matter.

Where the authorities on the manufacture of cane-sugar, employed by the Imperial and Provincial Governments, obtained their experience in sugar manufacture I know not, but mine has been obtained in designing many of the cane-sugar factories in the West Indies and other cane-growing countries, and in the practical manufacture of cane-sugar in Egypt and in Mauritius, and in Indian Jaggery Refineries during a period of 24 years, and my experience seems to be totally different from theirs.

SUGAR-MAKING IN SOUTH INDIA

An Experiment in Mysore

Mr. A. E. Jordan writes in the "Madras Mail":—

The attached letter should prove most interesting to everyone, be he native or European, engaged in agricultural work. In 50 days of 16 hours each, Mr. Krishna Iyengar, of Ooraghally Estate, Mysore, crushed by means of a small 12 inches into 13 inches mill, 700 tons of sugarcane, and produced 118 tons of jaggery, which he sold at Rs. 120 per ton,

equivalent to a total value of Rs. 14,160, and if he had had the additional plant for making white-sugar direct from the cane, his product would have been 85 tons of white crystals, and 33 tons of molasses which would have had a value of at least Rs. 200 and Rs. 40 per ton, respectively, in all Rs. 18,320, and produced without a single pound of fuel being purchased except that required to make a start with:—

Dear Sir,—As promised in my last letter I herewith send you a short account of the working of the cane-mill supplied by you. The steamer which brought out the mill arrived at Madras on the 16th February, and after a delay of twenty days caused in landing and transhipping the mill arrived at my Estate on the 8th March. By that time, I had the oil engine, a 6½ B. H. P. one, fixed in position and in working order, and got ready the foundation for fixing the mill besides having the boiling pans, pumps, water-tanks, taps, etc., in fact, the whole show, in order. So I lost no time in mounting the mill on the foundation and fixing it in position. The plan of the mill supplied by you beforehand enabled me to do this to a nicety without the help of any prfessional fitter. I started work on the 14th March, and closed it on the 2nd May, crushing 25 acres of cane within that period, working at the rate of 16 hours a day. I could have worked more hours, of course, but as I had no prior experience of oil engines, I had not provided for two water-tanks for keeping the engine cylinder cool and had consequently to suspend work at the end of every eight hours, for by that time the water in the tank would very nearly get to the boiling point. Next season, I shall provide against this.

Dr. Lehmann, the Agricultural Chemist in this State, kindly visited my Estate and made experiments as regards the crushing capacity of the mill, the extraction, the quality of the juice and the jaggery produced. Your mill, I am glad, successfully stood the test and as the last minute of the hour expired the last cane of the ton experimented upon, came out of the mill crushed. The extent of my cane fields was 25 acres and contained 8,000 shoots, the acre giving an average of 28 tons of cane to the acre.

A ton of cane yielded 3½ pansful of juice of 180 seers each, which on boiling yielded 14 maunds of 27 lbs. of jaggery. I sold the jaggery at Rs. 120 per ton exclusive of commission, etc. My expenses for the conversion of cane to jaggery came up to 4 as. per maund or Rs. 100 per acre, including cost of establishment, cutting and carting of cane to

mill, oil, fuel, etc. I did not use the pith as fuel but used nearly 200 tons of good firewood. The cost of fuel could be cut short by using the pith, and I wish you will kindly suggest the use of some machinery for evaporating the juice using the PITH as fuel.

The news had spread far and wide that a cane crushing mill driven by an engine was for the first time to be brought to Ooraghally and worked there, so on the day the machinery actually arrived and was transhipped from Bidadi Railway Station, quite a crowd of people followed the carts carrying the machinery all the way from Bidadi to my estate, and very good naturedly rendered me not a little assistance. The noise caused by the lamp used for heating the vaporiser created not a little surprise as no steam issued out as when a steam engine blows out and many questioned me why the engine did not whistle.

Most of them studied intently the different parts of the engine and the mill and their working.

Every day brought hundreds of persons from all the country round and many came from distances of 30 and 40 miles. The ryots were not at all apathetic in this matter, as it is usual with them to be in other matters. More than the Sudras I found the Pariahs were eager to learn all about the machine. Some whom I employed to help me very intelligently and readily picked up all about cleaning, oiling, starting and stopping the engine. I have four of them now with me well trained. Two of the goldsmith caste volunteered to learn the work. They were given an opportunity to do so and have learned all about the engine and the mill. So, at the end of the season, I used to leave the machinery entirely in their charge.

Sometime ago, when you mentioned in the "Madras Mail" that I made 400 maunds of jaggery per acre and that I sold it last year at Rs. 2-8-0 a maund, Mr. B. K. Garudachar of Bangalore, contradicted the statement and said that it was not possible to get 400 maunds of jaggery per acre on large plots of 30 or 40 acres, and that if I at all had sold my jaggery at Rs. 2-8-0 it must have been to some of my tenants, during a festival. Now I have milled a plot of 25 acres, and on this I have managed to make very nearly 400 maunds, although the canes had dried up to some extent and had also deteriorated in sugar value by being overripe. This yield under these adverse conditions is mainly due to the higher extraction, your mill gave over the ordinary cattle mill.

I have a quarter acre plot for experimental purposes and on this plot and with the cattle mill I

used to make 100 maunds when the canes were quite ripe. This year on the same plot I have got 120 maunds, using your power mill, although the canes were overripe.

As regards the price at which I sold my jaggery last year, I wish to tell you that Mr. B. K. Garudachar himself bought two-thirds of my crop at Rs. 2 per maund, and after incurring the expense of carting from my Estate to Bangalore, warehousing and other expenses, and less in weight due to keeping for two months, made a good profit, and moreover asked me to sell the remaining third also to him. But as I had sold the jaggery at Rs. 2-8-0 to a merchant prior to his request, I could not oblige him.

In conclusion, I may mention that the loss I have sustained by the late arrival of the mill has been more than compensated by the satisfactory way in which the mill worked and the higher extraction it gave, the considerable time and labour it saved, not to speak of the advantage, I derived, by being able thereby to convert within a short time a large extent of cane into jaggery and place the same within the time stipulated in the hands of the merchants with whom I had contracted to supply a large quantity.

If this account will suit you, you may send it to the "Madras Mail."

N. Krishna Iyengar.

IMPROVEMENTS IN THE NATIVE MANUFACTURE OF SUGAR

[Reprinted from the Englishman]

There was exhibited at the Benares Industrial Show some improved machinery for the manufacture of sugar which seems likely to create a revolution in this industry in the cane-growing districts of Upper India and Bengal. Before indicating the character and objects of the machinery it will be interesting to explain that the improved apparatus has been worked out by a Mahomedan, who was educated at Cirencester and is now Assistant Director in the Agricultural Department of the Upper Provinces. In his preface to the pamphlet which has been published* describing the improvement, Mr. Moreland, C.I.E., the Director, states that "having ascertained that the native processes were wasteful and defective in various ways, I directed my assistant, Mr. S. M. Hadi, M.R.A.C., to take up the industry in detail and endeavour to remove the defects which I had noticed. His work has been carried out

* Bulletin No. 19, U. P. Agricultural Department,—"Improvements in Native methods of Sugar manufacture," procurable at Government Press, U. P., Allahabad. Price 2 annas.

during the past three seasons in consultations with me, and I consider that the results arrived at are now sufficiently promising to justify their publication."

It is interesting to recall in this connection the controversy between Sir John Strachey and Sir Ashley Eden which led to the utilization of Cirencester for the education of Agricultural students from India—Sir John Strachey had as "Lord Mayor righthand man," to use a designation often applied to him, advocated the creation of Agricultural Departments throughout India, but he only succeeded when himself Lieutenant-Governor, in establishing the one Provincial Department in the N. W. P. This was in 1875. Sir Edward Buck was the first Director. Stones were at once thrown at the new Department from every side. Sir Andrew Clark, the then member of Public Works, made a furious attack on the Department from Simla, and asked contemptuously how civilian amateurs dared to undertake experiments which were entirely within the province of Engineers. (Engineers were "Royal" then). Sir Ashley Eden from Calcutta mockingly took to pieces the first report of the N. W. Provincial Department and in one of the most amusing and clever official papers on record derisively enquired whether competition-wallahs were going to teach the Bengalis how to grow rice. "Let the Bengalis," he concluded, "work out their own salvation" and asked in pure jest, whether the Government of India would not like him to send two Bengalis every year to Cirencester in order that they might return to reform the rice-cultivation of their province. Sir John Strachey rubbed his hands joyously and cried "Let's take him at his word!" And so two Bengalis were for some years despatched to Cirencester, and although they have not reformed rice-cultivation, many of them have done yeoman's service in other directions—one, for instance, (Mr. N. G. Mukharji) who took the gold medal at Cirencester and studied at the Pasteur Institute has done more than anyone else, to combat silk-worm disease in the Tirhut districts, where the silk industry is consequently reviving; and now we have in the improvement of sugar-manufacture another example of the good work that can be done by a native of India, if the opportunity be given to him to receive a sound practical and technical education. Fortunately, it will be no longer necessary to send our students to Cirencester in view of the fact that fully equipped agricultural colleges are now rising from the ground in

almost every Province of India. Of these, not the least important, will be the institution of which the foundations are being laid by Sir Andrew Fraser in Chota Nagpur.

To return to sugar. The practice in many of the cane-growing districts of Upper India is for the cultivator to crush the cane and to express the juice, which latter is sold by weight to the sugar-boiler, known as the *khandsari*. It is needless to recount here the history of the cane-crushing mill, which was developed by the well-known Bengal planters—Messrs. Thompson and Milne and which has replaced, practically throughout India, the clumsy native mill which had held its own for centuries. That reform alone has placed untold lakhs of rupees in the hands of our cane-cultivators. What we are dealing with now is the treatment of juice after it has been expressed. It is true, that the cultivators often boils his own cane-juice without the agency of the professional man, turning out an inferior unrefined sugar or *gur*. But, the point at present is to indicate the improvement effected on the most advanced methods hitherto in vogue. These are of course those employed by the professional *khandsari*.

The leading features of the *khandsari*-system are described by Mr. Moreland to be the concentration of the juice in a series of iron-pans, placed over a furnace, until it assumes a semi-solid form known as *rab*. The molasses are pressed out of this by coolie labour and the sugar that remains is then decolorized by treatment with a water-weed known as *siwar*, and the final product is called *kand*—(hence the name of the professional.) "The problem," adds Mr. Moreland "that I placed before Mr. Hadi was to make more, better and cheaper *khand* by means within the reach of the native."

The quantity of *khand* is affected by the loss due to conversion of sugar into molasses technically known as "inversion"; by waste in separating the molasses; and by waste in the decolorizating process. All the defects which led to loss and waste in the *Khandsari*-methods have been minimized by Mr. Hadi's apparatus, which consists of improved 'boilers and a centrifugal-machine' combined, with simple chemical appliances. We must refer those of our readers who are interested to learn in detail the character of the apparatus and chemical appliances. It must suffice here to indicate the results. "The yield of *khand* from a given quantity of juice is increased,"—writes Mr. Moreland—"by at least 25 per cent., and the "value" of

the season's produce from a single-boiling-plant is about Rs. 7,700 by the new processes, against about Rs. 6,000 by the old. In other words, by more than 28 per cent."

The "quality" of the KHAND depends chiefly on the colour. "The slightest tinge of yellow or grey, affects the market value considerably and any pronounced colour makes the product almost unsaleable. The main difficulty has been to get rid of the colour, but this problem has been practically solved. The ultimate product is so clean a white that it is only by olacing it side by side with the best sugar of the European mills that the slightest shade can be detected. It is for all practical purposes of as good a colour as is required by any of the native dealers."

As regards "cheapness," the current expenses by the new process are under Rs. 8 per maund of *khand* produced, as against Rs. 10 by the old.

The apparatus which was shown in full working at the Benares Exhibition, where cane for the experiment was provided by the Hon. Mr. Madho Lal, the Secretary, attracted considerable attention, and many orders for it by natives interested in sugar manufacture were registered. It is satisfactory to record that the Raja of a Native State in the Upper *Provinces (Rampur), where a preliminary trial was made last year,* has this year given orders for Rs. 80,000 worth of the machinery. The price of the boiler-apparatus is said to be Rs. 400, and of the centrifugal Rs. 400 or 500 more, so that the total cost of a plant "*in situ*" may be said to be about Rs. 1,000. A leading English firm is in negotiation for the supply of apparatus, which can be worked by cattle labour.

The machinery is not meant, adds Mr. Moreland, for large capitalists, but for the type of men who are at present engaged in manufacture of small quantities. Regarding the importance of the industry the proverb he quoted was this :—

The importance of the sugar industry in the Upper Provinces and Bengal may be concisely indicated by the native proverb, quoted from the Indian despatches by Mr. Chamberlain, when the controversial debate on the countervailing duties took place in the House. Mr. Chamberlain's sympathy in the cause was, it may be remembered, enlisted by including Mauritius in the scheme for India. And the proverb he quoted was this :—

"As the elephant is to other animals, so is the sugar-cane to other crops."

Germany and Austria are still struggling to hold their own

in the Indian market, but the SWADESHI-MOVEMENT is doing much to counteract their efforts. Mr. Hadi's machinery will, perhaps, do more.

"I have taken out no patent for these processes," says Mr. Hadi, "partly because they were worked out at Government expense and partly because I thought that their protection under the Inventions and Designs Act might retard their free adoption by the Indian people."

"The processes are very simple and do not involve the use of bone charcoal or any other material to which Hindus or Mahomdans could have religious objection.

The suger produced is of a quality which suits specially the requirements of the Indian confectioner."

"It can be stated with absolute certainty" adds Mr. Hadi that the profits in this process cannot be less than 25 percent per annum on the total outlay.

MACHINES TO CLEAR SUGAR-CANE FIELDS.

Two Cuban inventors have invented machines to be used in the clearing of sugar-cane fields.

The first invention reported was that of Mr. Antonio Rodriguez, of Matanzas. His machine is built in rectangular box shape, supported on two wheels, which are 36in. in diameter. Inside the wheels is a gearing which, by means of pinions, moves a shaft from 45in. to 60in. long. This shaft moves three circular cutters 33 in. in diameter. The teeth of these measure one inch. The cutters are so placed that the teeth cannot touch the ground, and they are protected by a metal guard. The inventor asserts that the teeth will not need frequent sharpening. In front of the cutters there are small triangular iron pieces which drag along the ground, lifting the grass and weeds to be cut, and palcing the stems against the cutters, which turn in a slit. The machine is hauled by oxen or mules, a man driving from a seat which is affixed over the machine. The gearing is controlled by means of a lever at the driver's hand.

The other invention was made by Mr. Felix Cervants, of Havana, who has long been interested in agricultural matters. He has built a cane-clearing machine on the same general principles as the one just described, but there are differences. The body of the model of Mr. Cervants is a frame upholding the seat of the driver and supporting a sliding ballast controlled by a lever in front of the driver. By means of another lever the driver controls an endless

chain located on the inner side of the right-hand wheel, from which motion is given to several circular saws that move in grooves in two rollers. The rollers themselves are moved from the other wheel, their motion assisting the straw, which is to be cut, to pass through them to the teeth of the saw. The straw is lifted by a catcher, which projects from the front of the machine and rests upon a third and smaller wheel. The height of this catcher from the ground is adjustable. Mr. Cervants asserts that his machine is practical and that it will give certain and satisfactory results. He is also working on a cane-planting machine which, he says, will be different in principle from any machine used to-day.—INDIAN PLANTING AND GARDENING.

RAISING PEDIGREE SUGAR-CANES.

The first announcement repecting the possibility of raising seedling sugar-canes in the West Indies, was made at various time in Barbadoas between 1859 and 1888. A similar announcement was made in Java in 1887. Since that time, seedling-varieties have been raised, which are capable of resisting the attacks of disease which destroyed the older forms, as well as increasing the yield of sugar. Several experiment plots were maintained in the West Indies from 1888 to 1898, and the success of the result thus obtained must be very gratifying to those who were engaged in the work. The seedling-canes raised by Mr. Bovell and Professor Harrison in Barbados, by Mr. Jenman and Professor Harrison in British Guiana, and by Mr. Hart in Trinidad are now well-known in most of the sugar-producing countries of the world.

The earlier method adopted for producing improved seedling-canes was by means of a careful selection of casually produced seedlings. The identity of seedlings was derived from the seed-bearing parent only. A further step was raising the seedlings from canes planted in alternate rows, so that the pollen-bearing parent might be identified, as well as the seed-bearing parent. Experiments in this direction were carefully carried on in Java, Barbados, and British Guiana.

By means of a system of rigorous selections both in the field and in the laboratory, several good varieties have been raised, but a large

percentage of the seedlings produced, as was to be expected, have proved to be worthless. In any case, it took several years before a seedling-cane was sufficiently tested under varying conditions, to deserve to be recommended to planters, and even then, it was left to the planter himself to make a final selection of those which were likely to be suitable for his purposes. A seedling-cane might give very good results in a certain soil, or in a wet or dry season, while proving an utter failure in others.

The latter method of attempting to secure cross-fertilization between known varieties referred to above was carried out in Java and elsewhere, by carefully selecting two varieties known to arrow at the same time and planting them in adjacent plots. By those means, it was hoped that one variety would be crossed by the other. In some cases this, no doubt, took place. Another step was the bagging of the arrows some time before they reached maturity. On the ripening of the pollen, the contents of one bag were shaken into the bags of another variety, which was to be the female parent. As some of the seedlings were suspected of having been produced by pollination, *inter se*, some uncertainty still remained as to the parentage of the resultant seedlings.

An important step in advance was made in the hybridization of the sugar-cane, when it was found that certain varieties did not produce fertile pollen, while their pistil was normal, whereas other canes produced a very large amount of normal pollen. Taking advantage of this, the Imperial Department of Agriculture in 1902, started artificial cross-pollination, by means of which, the flowers of one variety were emasculated, while still young and then pollen was transferred from another variety by means of a camel-hair brush. Owing to the minute character of the flowers of the sugar-cane, this was a difficult process, especially as it had to be carried out while the operator stood on a temporary platform, 10 to 12 feet high. This experiment was, however, successfully carried out by Mr. L. Lewton-Brain, B.A., F.L.S., (now Assistant Director of Vegetable Pathology, Hawaiian Sugar Planters' Association) in November 1904, when he was Mycologist on the staff of the Imperial Department of Agriculture for the West Indies. He worked with some of the best of the Barbados varieties and obtained five seedlings, which proved that the raising of hybrid-sugar-canes by artificial cross-fertilization was practicable. The resulting seedlings are the first raised in the

West Indies, whose parentage on both sides is a matter of certainty. They are being carefully propagated, and instructive results are expected to follow. The method adopted by Mr. Lewton-Brain is fully described in the "West Indian Bulletin," (Vol. V, pp. 32-3.)

In view of the success of this work, it was decided, last year, to make systematic attempts on a larger scale. The work was entrusted to Mr. F. A. Stockdale, B.A., Mycologist on the staff of the Imperial Department of Agriculture. Owing to fluctuating variations in some of the new seedlings, only those which had stood stringent tests on a large scale, for a considerable time, were used in the experiments. Then an attempt was made to raise pedigree seedlings from selected varieties only. Of these, B. 147 and B. 208 were considered the best, and over 400 spikelets of these two varieties were emasculated and pollinated. Three sound canes were chosen in the varieties to be used, and at least a dozen spikelets in each arrow were operated upon. Crossing was then made in two directions,—the pollen-parent in one cross being used as the seed parent in the other; in other words, one variety was utilized as the female-parent. In all, over 600 spikelets were emasculated and artificially pollinated last year, and it is hoped that the results obtained may be such as will, before long, fully carry out the objects in view. A concise account is being kept of the crosses performed, and next year, it is hoped that a series of the investigations into the cytology of the sugar-cane will be carried on, with the view of determining exactly the right age for pollination, as well as over-coming many of the mechanical difficulties that have hitherto been met with.

If the results of the new method of breeding sugar-canes described above are still further extended during the next few years, and the line so successfully adopted by Messrs. Carton and others in raising new varieties of wheat and oats in England are closely followed, the prospects of the sugar industry in these colonies should be still further improved. There are now no good reasons why we should not be in a position to produce pedigree sugar-canes as well as pedigree wheat and oats.—AGRICULTURAL NEWS,—Jan. 20, 1906.

A NEW SUGAR PLANT

The Technical Review of Berlin makes mention of the discovery of a kind of plant in South America containing saccarine matter in abundance. "It

grows up to 8 or 12 inches in height. The Chemical expert, Mr. Bartoney, considers its plantation to be a verv profitable industry, in as much as it yields plenty of sugar. This sugar is many times more intensely sweet than the ordinary sugar. Another advantage is that its juice does not ferment easily.

The Superintendent of the Agricultural College of Ascension Island has found by trial that its sugar is 20 to 30 times as sweet as cane or beet sugar.

Its botanical name is *Eupatorum Rebundican.*

DATE SUGAR IN CENTRAL INDIA

Mr. Haridas Chatterjee, Pleader, Indore, has been engaged over this industry for many years post and is trying to introduce the Bengal system of tapping and extraction of juice and sugar-making. He is always ready to welcome energetic young men, earnestly bent upon business, going to him and will be glad to answer enquiries.

SUGAR-BEET

The high price of sugar in 1904, and the exclusion of bounty-fed sugar from the English market, have had the effect of again bringing into prominence, the question which has for many years been much discussed as to the advantage of manufacturing sugar in England from home-grown Sugar-Beet. The Essex Education Committee have, therefore, conducted certain experiments in order to find the yield and quality of the beet grown on typical soils and to compare some varieties. The results show that beets have been grown equal to and in some cases better in quality than those produced in sugar-making countries. It would seem, therefore, that a new and profitable industry has been but too long neglected. The business side of the question—the cost of production and the consideration of the local conditions prevailing in the Eastern countries, the cost of working a factory, and a host of similar points, need, however, careful and experienced consideration. Mr. George Clarke, who has assisted in preparing the Report, from which we now quote, issues the warning that nothing would be more disastrous both to farmer and to capitalist investing his money in the erecting of plant than, for the former to embark on the cultivation of Sugar-Beet on an extensive scale without a proper knowledge of the best

methods of cultivation, the varieties best suited to his particular neighbourhood, and the amount it would cost him to grow the crop. Still, there seems to be no reason, if due consideration be given to all these details, why a properly initiated undertaking should not be remunerative both to the farmer and the manufacturer. As regards as unsuccessful effort in this direction, started some 30 years ago, it is noted that the mean percentage of sugar in the beet used was 10.0. The mean of over 80 samples from different plots grown in Essex in 1905 is slightly over $16\frac{1}{2}$ per cent. of sugar. This is a striking illustration of the improvement in the quality that can be brought about by careful selection along the right lines. Cultivation is a matter fully as important as the choice of the best varieties of beet, and the subject of manuring also requires careful study. In the experimental plots it was found that the sugar content was considerably increased by the use of Sulphate of Potash. For further details of these important trials, readers should consult the pages of the Report, which is fully and instructively illustrated. It may be had from the County Technical Laboratory, Chelmsford.

INDIGO IN INDIA SAVED BY JAVA SEED

Indigo-brokers at Home have recently been holding out the hope that the introduction of the Java seed may be the means of saving the Indigo Industry in India. Mr. C. Bergtheil, Agricultural Bacteriologist to the Government of India, in an appendix, which he contributes to the Annual Report of the Imperial Department of Agriculture, has some interesting remarks to make about the Java plant in India. The plant, it appears, was first brought prominently to the notice of planters by Mr. H. Bailey, who visited Java on behalf of the Indigo Improvements' Syndicate in 1899. It has since, says Mr. Bergtheil, proved itself of the greatest value to the Behar planters, and its cultivation is spreading as rapidly as the seed supply forthcoming will permit. In a very few years this plant will, no doubt have almost entirely replaced the variety formerly grown in Behar. It was first grown on an extended scale at Dalsing Serai by Mr. Bernard Coventry, who has done so much for the Indigo Industry, and its advantages were apparent immediately certain difficulties in its cultivation had been overcome. The chief of these, the "*Englishman*" learns,

was the possession of a hard coat by the seed of the plant which rendered germination very difficult. It was suggested by Mr. Bergtheil, in 1902, that this difficulty might be overcome by suitably sacrifying the seed in a similar manner to that practised on clover and other hard seeds in other countries. The idea was taken up and proved feasible by Mr. H. Leake, the biologist to the Indigo Improvements' Syndicate and a machine has now been invented, by which the operation can be performed on a large scale with perfect success. It has, however, to be noted that the experiment of producing Java seed for use in Behar from a farm near Delhi has not proved quite successful, and, in Mr. Bergtheil's opinion, the cultivation of seed there should be discontinued and seed farms started in Behar.

ARTIFICIAL INDIGO

In an interesting communication, the Berlin correspondent of the leading newspaper recalls that, since Perkin first obtained colouring matters from coal-tar on a commercial scale, the artificial production of organic-colours has grown to be an enormous industry which has its chief seat in Germany, and has, indeed, become one of the principle branches of the chemical industries of the country. Two vegetable dye stuffs, the synthetical composition of which had been discovered—namely, madder and indigo—were manufactured with such success that in the case of the former the agricultural cultivation has virtually become extinct, its place having been taken by artificial alizarine, and a similar fate appears to the correspondent to await the growth of indigo, which colour is now being manufactured artificially with all the skill which science can bring to bear on it. The growth of indigo, that most important of all vegetable colours, the sale of which attains a value of about three millions sterling per annum, is constantly on the decrease, for, while the area under this crop in India averaged in the period from 1896-1900 about 1,200,000 acres, it sank in the years 1901-02 to 791,200 acres, and in the following year only reached 574,700 acres. A similar decline can be traced in Indian exports of indigo over the same period. The amounts were as follows, in round figures:—

1896-97	1897-98	1898-99
£4,125,000	£3,100,000	£3,000,000
1899-1900	1900-01	1901-02
£2,150,000	£2,100,000	£3,850,000

On the other hand, the value of artificial indigo exported from

Germany rose from £250,000 in 1897 to £1,250,000 in 1903.

The total value of synthetic indigo now annually manufactured in Germany is estimated by competent authority at about £1,500,000. Whilst the imports into Germany of indigo from India have dwindled down to a negligible figure, Germany now exports synthetic indigo in annually increasing quantities to the United Kingdom.

RUBBER AND COCOANUTS IN SIAM

By all accounts, says the "Siam Free Press," unprecedented interest is now being taken in the development of the Siamese Peninsula by the Bangkok Government. Along the whole Peninsula, from five to ten miles inland, the soil is admirably adapted for the cultivation of cocoanut trees. From ten miles inland—right up to the hills, where the soil is red and solid—the plantation of rubber trees will be carried on to a very great extent. With a view to the extensive cultivation of cocoanut, and starting Para Rubber plantations in the Peninsula, several syndicates are being floated. Two prominent Bangkok Europeans have obtained concessions in the province of Bandon. Another company is being floated, mostly of foreigners, who are going to start cultivating in other States supported in Bangkok by wealthy speculators. There are more who are seeking concessions for the cultivation of Rubber, in other favourable localities in Siamese Malaya. Almost every available spot in the whole Siamese coast line is to be brought under cultivation. Mr. Duff, it is said, now resigned the directorship of the Kelantan Corporation, is expected in Bangkok shortly in connection with some new concessions for the cultivation of Para Rubber. Thus the rush for rubber land and cultivation goes on apace, and all that remains for British Malaya is to start factories, and win the rubber trade of the world by supplying all manufactured articles at the lowest prices imaginable.

THE CEARA RUBBER TREE*

The cultivation of rubber has been "boomed" so greatly of late and the echoes of it have stirred even India so much that there seems to be a likelihood of a fair number of our landed gentry going

* For particulars about the rubber industry *vide* later, Part III. (Trade, Commerce and Industries.)

in for just a trial at the thing and diverting some of their capital in that direction. It may, therefore, be well to indicate briefly what the most profitable channel is in which to invest some of our not too abundant capital. The sorts of rubber most cultivated are the trees of the Para, Central American and Ceara varieties. Of these, to judge by the opinions of experts, none seems to be so well adapted for this country as the last named. It is true that it is not very easy to say exactly what amount of rubber the Ceara tree will yield and this fact has often resulted in hasty condemnation of the tree. But all recent testimony is entirely in favour of its suitability to Indian conditions. It has the great virtue of adaptability to an extent not possessed by the other two named. The latter insist upon peculiar conditions of soil, climate and rainfall before they grow to any profit. Not so the Ceara. Anywhere from sea-level up to 4,000 feet above it, in any soil fertile or barren, in any atmosphere saturated with moisture or as dry as is to be found anywhere, it will sprout and develop. It has been found to flourish not only side by side with the Para and the Central American, but in places where they cannot hope to raise their heads. Nor is this all. For the tree, in addition to the rubber, is capable of yielding another product of considerable commercial value. Out of the thick fleshy roots can be extracted a rich starch which is said to be excellent for biscuits. This farina prepared from the roots has the appearance of arrow-root and, according to one European authority, "it has nothing to compare with it for the making of puddings and custards." So appreciable is the quantity that can be got out of the tree and so valuable is this product that, apart from the fact that the rubber yielded is in every way of as good a quality as that of the kinds first mentioned, Ceara seems to be worth going in for on account of this starch alone. The cutting of the thick roots is, of course, necessary for farina-extraction. But this process does not at all interfere with the amount or the value of the rubber producing milk. In short, for cultivation on a commercial scale in this country, it would appear, as if there were no other to compete with the Ceara. And to those whose inclinations tend that way, we would recommend the study of an excellent monograph on the subject by Mr. Proudlock, published in 1899, as a preliminary to their embarking upon their enterprise.—Hindu.

COCOANUT PALM IN TRAVANCORE

That the Cocoanut Palm is a valuable material asset to Travancore is a fact well-known to those who know anything of that State. The value of Kopray exported for one year, was Rs. 4,496, 514: of cocoanut oil 1,377,622: of coir 3,810,076: of fibre 7,904 and of cocoanuts 387,679. Besides all this, the value of the jaggery exported comes to Rs. five lakhs. It is evident from this, that a number of people depend for their livelihood on the cocoanut industry and the Government derives a large income from it. Notwithstanding all this, it is disappointing to learn that the Government have not taken any steps to improve its cultivation. People owing to ignorance, are still sticking to their ancient methods. In the neighbouring Island of Ceylon, on the other hand, the Government has taken steps to develop and advance the industry. In this connection the "Malabar Daily News" suggests the appointment of an expert to advise on the best means of combating a blight which affects the plantations now and then. Our contemporary says:—"It is true that we do not hear much of this blight now-a-days, but the fact still remains, however, that the cocoanut planting industry is far from being as profitable as it was a few decades back. There is still necessity, therefore for the State to interest itself, practically, in the question of restoring the industry to its one-time prosperous condition." We trust our contemporary's suggestion will receive due consideration at the hands of the Government of Travancore.

—UNITED INDIA.

THE SOAP-BARK TREE

Jacaranda writes in the "Capital":—Vegetable Soap is a commodity likely to find favour with the high-caste peoples of this country, owing to religious prejudices which preclude some millions from using ordinary soap—a lamentable fact from a hygienic point of view, but bountiful Nature being ever mindful of human needs, has given India the soap-nut tree (*Sapindus emarginatus*), the *Rheeta* of the natives of India. It is not the "nut", however, that is utilized as a substitute for soap, but the fleshy pericarp of the seed vessel. The *Rheeta* tree, though a native of India, is not found in plentiful supply that is, in a wild state. Why it is not planted largely is just one of those things that "no fellah can understand."

In other countries they do things differently. For instance, in South America, notably in Chili, there is a tree that grows to a height of some 60 feet, which yields a bark that is used as a substitute for soap. It is known as the Quillai or Cullay to the Chilians, and is the soap-bark of English commerce. Botanically, it is known by the name of *Quilloja Saponaria, Mol.* Curious to relate, the tree belongs to the Rose family (*Rosaceæ.*) It is described as being found growing wild on the outer slopes of the Chilian Andes. It also extends to the Southern part of Peru, and has been found growing upto an elevation of 6,000 feet above sea-level. The timber of the large trees is very hard and durable, and is in great request in mines. But its principle economic value lies in the bark, which in recent years has formed the basis of a considerable industry some 5,000 bales annually finding their way to London.

Now this is a tree that strikes me as being eminently suited to certain parts of India—and the plains, however, and the reason why I am now drawing attention to it is that the tree has been practically naturalised on the Nilgiris. In 1884, some seed of of this tree was sent from the Royal Gardens, Kew, to the Government Botanist, Madras, for experiment. Mr. Lawson in that year reported that the plants raised from seed were doing very well at Ootacamund. In 1886 Mr. Lawson again reported as follows:—"This plant thrives well in Ootacamund, and it is found that it can be readily propagated by means of cuttings; so that if it proves to be a tree of any value, it can be increased to any extent." Since then nothing more appears to have been heard of the soap-bark tree; except that in 1894, the Government Quinologist, Madras, reported as follows to Sir D. Morris, Director of Kew:—"You will be glad to know that the Quillai Bark tree grows well here (Ootacamund), and the bark of a ten-year old tree, contains as much saponin as the bark, found in the London market. I do not know if the tree has been tried anywhere else in the East."

From the foregoing, it will be seen that in so far as the experimental cultivation of the tree is concerned, it has been eminently successful. Why should not this tree be planted all over the Western Ghats at elevations from 3,000 feet upwards? There are hundreds of miles of hills of this elevation where the tree could be planted as a forest tree and would prove a valuable asset to the Forest Department. That there is a brisk demand for the bark in London, is proved by a letter written by

Messrs. Burgoyne, Burbidges & Co., to the Kew authorities, in which they state :—"There is a good and increasing demand for this article, prices at this moment (1894) ranging from £12 to £12-10s. per ton." Being easily propagated by cuttings, there ought to be no difficulty in spreading it rapidly. At Mahabaleshwar, Panchgani, and similarly situated places, where the forest trees are of low growth, the soap-bark tree would be a welcome addition to the sylvan flora of those beautiful hill stations, besides providing a valuable trade product, for which there is bound to be an enormous demand in India itself, as soon as the high-caste Hindus and Brahmins come to recognise in the bark, a vegetable soap.

Besides the value of the bark as a vegetable soap, it possesses other valuable medicinal properties. Dr. R. Kobert has proposed the bark as a substitute for *senega*. He found that the two glucosides occurring in senega-root are present in Quillai-bark in almost five times the proportion in which they occur in senega. As Quillai bark contains a tolerably constant proportion of the glucosides, and as it also contains a considerable amount of sugar, which gives the decoction a sweet taste, and being much cheaper than senega, it offers certain advantages over that drug. Kobert's experiments proved that patients bear Quillai bark better than senega ; that it rarely produces vomiting and diarrhœa, and is readily taken by children while its expectorant action is beyond question. In Chili the bark is powdered and used as a substitute for soap in washing clothes, two ounces of the powder being sufficient to wash a dress. It is also claimed for it that it will remove all spots or stains and impart a remarkable lustre to wool. It is also used as hair-wash, and is held in high esteem by women as a hair-tonic.

Altogether, the tree appears to be one of economic value, and as it is already acclimatised on the Nilgiris, there should be no difficulty in spreading it all over the Western Ghats, on the lower slopes of the Himalayas, and in the Jaintia and Khasia Hills.

ORANGE CULTIVATION IN COORG

[By Gastav Haller]

Of the fruit in Coorg, oranges are by far the most valued. There are several varieties, of which the *Loose Jacket* ranks foremost. It is so named, because the skin covers very loosely the eatable fruit. Since the deterioration of coffee-cultivation, more attention

is being paid to orange-cultivation. The demand far exceeds the produce and for years to come there can be no fear of over-production. In Coorg, oranges thrive best where the monsoon rainfall is not high, where heavy mist and fog are exceptional, and where high winds do not prevail. A fairly good soil is also necessary.

The method of cultivation is very simple. Seeds are sown in nurseries, where the young plants remain until they are about one or two feet high, and then they are transplanted 18 to 20 feet apart, *i.e.*, 109 to 133 trees to the acre. The only attention subsequently necessary is to protect the plants from damage by cattle, and to keep the field clean from weeds or shrubs.

After six to seven years the first crop is picked, and if a garden is to be a success, the trees should be manured yearly with either cattle-manure or leaf-mould. But very little is done in this respect, and the orchards are generally left to take care of themselves. The time of flowering is October to December or April to June. The fruit from the October-blossom are of very little use, as they do not ripen properly, forming the so-called monsoon-crop for which there is no demand in the market. The crop from the April-blossom, which is of great value, is harvested from January to March and is known as the hot-season-crop. One dozen oranges of the latter sell at from four to eight annas. Very little care or attention is devoted to regulating the flowering of the respective crops. Some cultivator beat down the flowers with a long bamboo. This is successful, if carefully done, and produces the result that the trees are in flower again in April, thus yielding the crop in January. It would perhaps be more effective if the twigs bearing flower were cut off; but such pruning would be very troublesome.

Experience has shown that after thirty years, the orange tree ordinarily begins to decay. But this is to a great extent due to neglect of the trees. The existence of trees older than thirty years in full vigour, and yielding good fruit, is evidence that if care be bestowed the vital powers of orange trees are not necessarily limited to thirty years. But many orange trees get destroyed within a much shorter period if attacked (*a*) by a parasitical creeper belonging to the *Loranthus* family, or (*b*) by two kinds of worms which bore through the stems.

As regards the *Loranthus* creeper, it is commonly known in Coorg by the natives as *Bandalike* which is interpreted in the Dictionary of the Rev. Dr. Kittle as follows :—"A parasitical plant;

the parasitical plant,—*Epidendrum tesselatum.* The parasite is well-known to almost every ryot in Coorg. It attacks almost every species of trees and kills the largest forest trees. The leaves and colour resemble very closely to those of the trees on which they feed. The flowers have a dark red colour and each plant distributes millions of seeds. Each fruit contains one seed, which is enveloped in a very strong mucilaginous pulp; the seed is carried to another tree by birds, to which it adheres. The propagation is therefore by seed, and not by roots. If the plant is not disturbed, it assumes great dimensions, spreading roots over the trees on which it grows and destroying them in a few years. The means of checking this parasite are very simple; the branches affected must be cut off together with the parasite, as otherwise, it feeds on the dying branches and still succeeds to ripening its seed. Simple as the method of destroying this kind of evil is, yet but rarely is any attention paid to it.

As regards the borer, the problem is more difficult. The boring worm becomes a beautiful green beetle,—*mallichroma sp.* In the bores is also found an insect (a *Locustid*) which is apparently predaceous upon the borer. This insect is the enemy of the beetle and when placed near it sometimes attacks it furiously and kills it. The former is very powerful and if carelessly held can bite so that the blood flows. Mr. H. M. Lefroy, Entomologist to the Government of India, on consultation kindly furnished me with the following:—"The *Locustidoe* are often predaceous and your case is a very interesting one that should be on record. * * * Three borers are usually not easy to deal with. We found the bent were for extracting the grubs, kerosine injected into the bores, and catching the beetles by hand in the early morning, the best, remedy for tree borers of this kind in the West Indies. It all depends upon the time of emergencies of the beetles." Careful enquiries go to show that these beetles and locustides emerge from May to September, *i.e.*, about the same time as the coffee borer. The worm bores in intricate passages through the trees, and leaves behind it a very hard mass of pulp so that the insertion of wires or injection of kerosine into the bore-holes is impossible. These insects prefer trees which are not happy and fortunately it takes a good many bores to kill an orange tree. The best remedy would thus appear to be to manure the gardens heavily so as to keep the trees in good condition. Old trees, which are beyond recall, should be cut down and burnt.

in order to destroy all eggs, worms, beetles which they may contain.

Holders of orange gardens need one word of caution in the selection of seed. Instead of procuring the very best oranges for seed and selecting from such the best seed, there is, as a rule, no care devoted to this important subject. Imperfectly developed seed cannot produce healthy plants, and although subsequent care with regard to manuring, may improve the tree, yet with a little attention at the outset much disappointment may be saved. -AGRICULTURAL JOURNAL OF INDIA, 1st Qr., 1906.

HINTS ON ORANGE CULTIVATION

In the Jamaica "Gleaner" for February 1, 1906, the following suggestions for promoting the earlier ripening of oranges are embodied in a letter to the Colonial Secretary from the Director of Public Gardens and Plantations.--(1) Removal of all fruit late in October or early in November. (2) Removal at the same time from the trees of all dead-wood, lichens, moss, and other growths—this, of course, should be also done throughout the year. (3) Opening up the main-roots for 1 foot or 18 inches from the stem, and removing the soil from them (4) Application of lime on surface of ground from stem as far as branches extend; all the above work to be finished during November. (5) Forking up the soil in December for a breadth of 1 foot all round the tree, just outside the extremities of the root-system, and application of wood-ashes, bones, and a little well-rotted pen-manure to it, or the equivalent in commercial fertilizers. (6) Maintaining a mulch of grass, etc., from January until the fruit is full, and then removing it. (7) Irrigation, whenever possible, by using waste water, etc., during the same months that the mulch is used. (8) Thinning out the fruit by one half when they are about the size of marbles.

THE CULTURE OF THE ORANGE

The orange, in the widest sense, (*Citrus aurantium, Lin,*) is a native of Southern Asia. The tree lives to a great age, there being orange trees as old as 600 years and upwards. The orange tree can be grown in nearly all the countries within the tropical and sub-tropical zones. It abounds in the East and West Indies and the islands in the Pacific. In commercial importance the orange

fruit comes next to the vine. The rind of many varieties of oranges also yields a valuable essential-oil. Neroli oil, a delicious and costly scent, is obtained from the flowers of the bitter orange.

In Central India there is a peculiar variety of orange which produces two crops a year. The blossoms which appear in February and March yield their ripe fruit in November and December; whereas from the flowers of July mature fruits are obtainable in March and April. Only alternate plucking is allowed to prevent exhaustion.

All varieties of the orange tree may be raised from seed. Those raised in this manner will produce fine fruit, and if not suffered to grow to trees, may be used as stocks for budding. Once fairly in growth the tree requires only attention, and plentiful watering during dry weather and manure in the form of cow-dung. The tree may also be propagated by layers.

One of the best species of oranges is the *Cuntra*, supposed by many to be the same as Cintra, Cintra in Portugal being famous for oranges. It is, however, hardly possible that this tree was introduced into India by the Portuguese, for then it would have been specially abundant on the coast. But instead of that it is found more often in the interior, and hence it is probable that this species of orange was introduced into India from China or Cochin China, hundreds of years ago. This was the conclusion arrived at after a thorough investigation of the subject by Sir F. C. Bonham, Secretary to the British Embassy at Lisbon.

The *Cuntra* orange is regularly cultivated in the neighbourhood of Poona, Satara, and Ahmednagar. The rearing of this species of orange requires greater care than that of *Kowla* and *Laddu*. These three species are hard to distinguish from one another, but may be recognised by carefully noting certain differences in their bark, their shape and their colour. All these trees are remarkable for the sweetness of their fruit, specially the "*Cuntra.*"

The trees of the *Cuntra* species are very straight and do not give out many lateral branches. Hence the grown-up tree resembles to some extent an umbrella turned upside down. The *Kowla* tree is thinner and has many branches stretching in a downward direction. Its ashy colour seems to suggest that the tree is withering from drought. The *Laddu* species emits branches close to the roots, and when fully developed it has a shape nearly circular, which circumstance probably accounts for its nomenclature. It has dark green leaves which are

also much smaller than those of the other two species. Experts state that when the cutting of a "Cuntra" orange has well taken to the stock, the latter should be cut off above the graft, which should then be well watered. The severance may be made two inches above the joint, and is often done when the plant is still in the tub. Another view is that the stock should be severed after the tree has been planted in the garden and begun to draw nourishment from the soil. In the latter case, there is less risk of the death of the plant.

After the top of the stock has been removed the next branches will issue from the graft. A cloudy day is favourable to the growth of branches and leaves. Branches may also be given out by the original stock and should be removed every time. For vigorous growth the grafts should be well-watered in the nursery. In the course of a year the young plants attain a height when they are planted in gardens.

The orange is much cultivated in Australia, and large quantities of the fruit are sent to England annually. As the orange is a surface-feeding plant, the Dutch hoe is used in cultivation to avoid all injury to the minute root-lets with which the ground under old orange trees is covered. To manure the plants, guano is largely employed. This is spread around a tree which shows signs of languishing on the surface of the land, and is then touched in with the hoe. By this treatment both trees and fruit are beautifully clean.

In Australia oranges are mostly raised from seed. In selecting seed for sowing, only the fullest and finest oranges are chosen. The seed is sown wide apart, in order that the young plants may not be crowded together. The system of raising seedlings in close row is found to cramp their capabilities of growth. Seedlings take some five or six years to come into bearing, but they make the finest trees, and that is what the Australian grower mainly desires.

THE *SHATI*—A VALUABLE ECONOMIC PRODUCT *

The '*Shati*' belongs to the bulbous species of plants, similar in appearance to the turmeric. It grows wild in most parts of Northern and Eastern Bengal, flowering in autumn and dying in winter. Sprouting up again, the next season, from the bulb that remains under-ground.

* *Vide*, on this subject, heading "Utilisation of vegetable products" (Part I, *ante*) and "Trade for those without capital" (Part III, *post*).

The bulb and roots occupy an ancient place in the Ayurvedic Pharmacopœa of India for their medicinal properties and have been in common use since the days of old for various purposes. That its properties are none the less recognised by modern Practitioners of the English medical science will be evident from the following notice of it in Dr. Rai Kanaye Lal De Bahadurs' work on "Indigenous Drugs of India":—

"The rhizome '*shati*' is to be regarded as a mild carminative and aromatic stimulant, useful in flatulence and Dyspepsia and as a corrector of purgatives; combined with alum in water it is also applied to bruises."

The bulb-powder mixed with milk, acts as an efficacious poultice to boils which helps them to burst.

As a food, its property is unique and in this respect alone, in these days of artificial foods, its possibilities are immense.

The '*Shati*' passes by the name of '*Tikhoor*' (তিখুর) in the western parts of the country and is botanically called the '*Curcuma Zeodaria.*'

The plants grow spontaneously out of the ground every year in the rainy season, no cultivation or care of any kind being necessary for its growth. On the contrary, it is so very prolific that once a bulb has taken root in a soil it goes on multiplying itself and spreading all round at such a rate that it becomes a next to impossible task to eradicate it. It often happens in consequence, that vast expanses of soil are seen at one stretch covered with nothing but a dense natural plantation of "Shati," which with their beautiful red flowers are a delight to the eye—and the owner of the land does not know what to do with them and such indeed is the fate of many a natural source of wealth in this ill-fated country of ours. This affords one more illustration of how the generous gifts of a too bountiful nature are apt to be abused. There is wealth lying about our very doors, if only we had the eye and the mind to turn it to account.

The '*Shati*' powder, as at present known, has the following principal uses:—

(1) as '*Palo*' or food
(2) for adulterating red-powder (*Fag* or *abir*)
(3) as medicinal ingredient.

The '*Palo*' which is the name for '*Shati*' in its powdered form has been a favourite substitute for sago and barley powder in the Eastern Districts of Bengal since time immemorial and is a household word even now. Dissolved in boiling water, it takes the place of cow's milk and is even superior to it in effect, considering the

poor quantity of cow's milk available these days. The infants fed on *'Shati'*-yield to no cow-milk fed infant in vigour and healthiness of physique. At any rate, the one great tangible effect is that the *'Shati'* fed infants are free from liver troubles which are the crying complaint of milk-fed infants, specially in cities, now a days.

As a food, it is very nutritious, at the same time, light and appetising and is equally beneficial to adults in health or as a sick-diet. It forms a principal ingredient in many preparations of home-made sweets and cakes.

The process of making the *'Palo'* is the simplest possible. The bulbs are washed clean, peeled and then thoroughly pulped and pulverised in the *dhenki* (country paddy-husker) and then put in a vessel with water which after a thorough stirring and straining is allowed to settle for hours together. The yellowish juicy matter which is very bitter in taste floats at the top and is gently poured out. Fresh water is put again and the stirring done as before and the vessel is kept aside undisturbed for 6 or 8 hours at each stretch. The same bitter juicy water—but less and less yellow in colour and bitter in taste at each successive washing—comes at the top which is poured out. By this process of washing repeated for 4 or 5 days, a complete elimination of the distasteful yellow ingredients is effected and a milk-white sediment gathers at the bottom of the vessel which is the much-prized *'Shati'* in its edible form.

There is rank-growth of this plant in most of the districts of Eastern Bengal and one has only to go with a spade in hand and basketfuls of the root-bulbs can be gathered in no time.

A Company was formed in 1900 with the name of the "Light food Trading Co." with a view to popularise *'Shati'* in the market and it is a hopeful sign of the times that its wonderful properties are being, though tardily, appreciated by the people. This Company turned out a kind of biscuit with *'Palo'* but it is not yet as good as the high-class varieties of foreign make.

At all events, there is a vast opening in this direction before the country.

CANNA AS A FAMINE FOOD

In the "Capital" there appeared an interesting article on the common Canna or "Indian shot," with especial reference to its possibilities as a producer of edible starch. That one particular variety of this family, *"Canna*

edulis," yields an excellent arrow-root is comparatively well-known. It flourishes in this country but is grown especially in Queensland, and a sample thereof according to an analysis described in a recent issue of the "Queensland Agricultural Journal", contained as much as 81·87 of starch, of which 4.3 was soluble starch, and .06 of proteid. By a strange provision in the Foods and Drugs Act arrow-root made from "*Canna edulis*" may only be sold in Great Britain as "Queensland arrow-root." The writer in "Capital" quotes no figures but he asserts that "almost every species of Canna contains an abundance of edible starch in the central axes of the contorted rhizomes. Taking into consideration the very accommodating habits of these plants, and their ability to thrive almost anywhere, in good soil and bad, in dry climates and in places where the rainfall is heavy, at high elevations and at sea level, the common Canna would appear to be well-worth growing not only as one of the brightest gems in our gardens, as at present, but also as a profitable source of arrow-root; the latter more especially in times of drought and scarcity.

*CULTIVATION OF FLAX IN INDIA**

Arrangements have been completed by the India Office for an early despatch to Calcutta of ten tons of Russian and Belgian flax-seed of the best quality obtainable, for an experimental cultivation in India. The Director of Agriculture, Bengal, will arrange with the Inspector-General of Agriculture in India for the distribution of the seed on favourable terms to planters and others who may desire to take part in the experimental cultivation of flax.

GROUND NUTS

The plant has been known in India since about the last 60 or 70 years. Its original home is believed to be South America but none can say authoritatively how it came to be naturalised in this country. Perhaps it came through China as its name "*Chínár bádám*" would seem to indicate, some think, through Africa. In southern Arcot it passes by the name of Manila nuts, which induces a presumption that it might have come from America, through the Phillippine Islands. That the

* For other particulars, *vide* Part IV, The fibre Industry, *post.* p. 38

plant is not indigenous seems certain, as otherwise, there must have been some mention of it in the ancient Sanskrit works.

Whether the plant is indigenous or exotic or whether it came to India, *viâ* China or Manilla, is altogether immaterial. There is no doubt, however, about one point and it is that in the nuts which the plant yields furnish an economic product of vast commercial importance to the country, which it behoves us to make the most of.

For the first time in 1848, oil extracted out of these nuts was exported out of India, and since then, its cultivation and export of oil have gone on increasing by leaps and bounds. The oil is a great rival to the French olive oil which has been going down in popularity by the extent this nut oil is rising.

In whole, India the normal area under this plantation is about 100,000 acres, the Bombay and Madras Presidencies claiming the bulk of the acrage between them in the ratio of 2 to 1, while Bengal accounts for a nominal share in it.

There is a great demand abroad for these nuts for oil-making. Year before last, 96,242 *cwt.* of them from Bombay and 13,744 *cwt.* from Madras were exported to Europe and America. Most of these were re-transported to this country after a circuitous process, in the shape of manufactured oil. The oil-cakes, being rich in nitrogen, are a very good manure, even more efficacious than castor-oil-cakes though a trifle more costly. They also serve as excellent food for cattle. It is obvious that the gain to the country would be immense, were the nut industry in its oil-making branch be taken up in right earnest. The crop is a highly remunerative one, yet, its cultivation is by no means keeping pace with the enormous demand, and Bengal, in this respect, is particularly behind-hand. Its oil is in great requisition in Calcutta and other big cities for adulterating other oils and *ghee*. It is also useful in the process of soap manufacture and as lubricator of engines and machinery.

Of the specimens of nuts grown in India those of the Tanjore side are reputed for their high percentage of yield of oil. In the vicinity of Pondichery, which is a centre of this nut trade, the oil is largely used in the manufacture of red dyes and leather.

DATES IN THE PUNJAB

Experiments in the cultivation of dates are, says the "Civil and Military Gazette," being started

afresh and on new lines in the west of the Punjab and Sind, where the climatic conditions are favourable. Too little regard has been paid to those conditions and to methods of cultivation in former experiments and their failure, need not be regarded as conclusive evidence of the unfitness of date to flourish in this country. Varieties have now been imported from many parts of the world—the Gulf and Muscat, Egypt, Arabia and Algeria--and the results ought to afford ground for definite opinions about date-growing in India.

MOST POPULAR FRUIT IN THE EAST

Some years ago, says a Rangoon paper, the *durian* used to be the most extensive fruit in Burma. But it has been more extensively cultivated in recent times, and the imported Bombay and Malwa mangoes not often cost more than the *durian*. The latter is undoubtedly the most popular fruit amongst Asiatics, whilst some Europeans also appreciate it. Mr. Alfred Russel Wallace said, he thought it was worth a voyage from Europe to taste the *durians*. He described it as a rich butter-like custard, highly flavoured with almonds, but intermingled with it some wafts of flavour that call to mind cream-cheese, onion-sauce, brown sherry, and other incongruities. "It is neither acid, nor sweet, nor juicy, yet one feels the want of none of these qualities, for it is perfect as it is." The Dyaks esteem it above all other fruit. They eat it unripe, both cooked and raw, and salt the pulp for use as a relish with rice. The Burmese often make a meal of the ripe fruit mixed with rice, whilst they make a preserve of it with oil and sugar.

Supplemental

INDIGO-RED *

New Dye Discovered

Considerable scientific as well as industrial interest attaches to the discovery, just made, of a new red colouring matter, of which the "Tribune" gives the following account :—

This indigo-red, as the new compound is named, is a remarkable product, for not only is it applicable to all the vegetable fibres with the production of a fast red, but also to the animal fibres. Further, the event itself, synchronising as it does with the scientific import and novelty attached to the discovery of the dye, is distinctly illustrative of the latest achievement of modern chemical technologists. The new dye-stuff

* See *ante* p. 65 on similar subject.

is a definite chemical compound closely related in constitution to indigo, in fact prepared from indigo. It is prepared, not by any process of extraction, giving small yields, as in the acquirement by chemical methods of the so-called "indigo-red," known for a long time as a constituent of natural indigo, but by a method of conversion by substitution giving quantitative yields. In point of fact, although the patents relating to its preparation are not yet published, it is to be regarded as a sulphur substituted product of indigo.

Here rests the novelty and scientific importance connected with this indigo-red, for searching as have been the investigations during the last century of chemists and scientists into the nature of the constitution, the analysis and the synthesis of indigo and other organic compounds the latter body itself, considered as a subject for conversion into other products, had hitherto yielded no results of any industrial value.

This is all the more surprising as indigo, known as a dye-stuff for thousands of years, was essentially the first dye in which experiments were conducted. These were so far prosecuted that, as long as eighty years ago, at a time when the application of chemical knowledge to experiments of this nature was necessarily somewhat tentative and crude, the chemist Unverdorben succeeded in obtaining from it the aromatic compound aniline, the initial step making possible Perkins' chemical researches thirty years afterwards. Indeed, so much attention has been devoted by chemists to indigo, since that time, that a practicable method was elaborated in 1882 by Baeyer and Drewson for its synthetical preparation—a fact now well enough known.

In spite of all this, attention in various directions, there has been hitherto obtained from indigo no colouring matter of especial value, with the exception, of course, of its sulphuric acid—indigo carmine which has been known for a long time. Besides this, then, the compound of interest produced from indigo by a process of conversion is what is known to chemists as its "oxygen analogue," itself valueless as a colouring matter and of scientific interest only.

Dr. Friedlander, of Vienna, the discoverer of this indigo-red, seems to have the happy thought to pursue the subject of preparation of the "sulphur analogue" of indigo, and the results, the discovery and the industrial preparation of the new dye, may reasonably be looked upon as the forerunner of other important discoveries in technical chemistry.

FOOD OF PLANTS*

The essential conditions for the growth of most of our cultivated plants are that they shall have favourable light, air, temperature, and moisture for the growth of the leaves, stems, flowers, and fruit; together with a favourable amount of air and moisture in the soil, and such soluble plant ingredients as nitrogen, phosphoric acid, potash, and lime, as are best adapted to the particular crop to be grown.

The demonstration of these requirements has placed in the hands of the gardener, the means of maintaining and increasing the fertility of the soil, and has enabled him in many cases to make soils productive that before were barren.

The knowledge, that plants need light and air, and that the larger portion of their food comes from the air, has brought about a modification of cultural practices by giving plants more room in which to grow, with a consequently greatly increased yield. Based on a scientific knowledge of nutrition, the art of feeding plants has developed within the last fifty years in a most remarkable manner. The well-informed gardener now knows, that the varying combinations of essential conditions and slemsuts that occur naturaly in different soils and climates are an index to the adaptability of these environments for special crops. The gardner knows also, that these conditions can be modified favourably or unfavourably by cultivation and manuring. He understands the importance of a physical and chemical examination of soils, are indicative of the presence or absence, and the relative proportion of the essential elements of plant-food.

The final test, however, is the physiological one of determining by actual trial whether certain crops are adapted to particular conditions, and how the conditions may be made more favourable. The physiological examination should also determine what beneficial or injurious micro-organisms are present in the soil, and the changes which these agents produce. There are some bacteria and fungi that cause the decay of the organic remains of animals and plants, leaving the nitrogen and other constituents of plant-food in the form of compounds available to crops. On the other hand, there may be present organisms which produce substances in the soil, directly or indirectly unfavourable to crops. The life history and habits of all these bacterial forms must be

* *Vide* on this subject, the opening articles in this Part, pp. 3-22.

carefully determined, and the useful kinds put to work and the injurious ones eliminated.

Very little has yet been accomplished in this particular field of research, except in connection with the problem of nitrogen-fixation.* Many investigators, both in this country, and on the Continent, have worked upon the latter problem, and step by step most important facts have been discovered. Physiologist have succeeded in working out the complete life-history and habit of the root-tubercle bacteria, which living in the roots of legumes—Beans, Pears, Lupine, Clovers, etc.—secure nitrogen from the atmosphere, thus enabling these crops to grow luxuriantly in soils devoid of this, scarcest and most expensive of all plant-foods.

Soils poor in nitrogen may, by the use of these bacteria and proper legumes, be enriched from the inexhaustible supply of nitrogen in the atmosphere. The nitrogen-fixing power of these bacteria may be considerably increased by additions of lime, basic slag, potash, and super-phosphate to the soil. For example, in one of the experimental fields of Rothamsted, the growth of red clover has been increased from half a ton of produce per acre on ground which has been unmanured for over fifty years, to three tons per acre on adjoining land which has received potash, lime, and phosphoric acid as manure, but no nitrogen, whatever, for over fifty years. And notwithstanding the large amount of nitrogen, which three tons of clover hay would take from the soil, the land has become so greatly enriched in fertility that more than double the quantity of wheat can be grown after the three tons of clover has been removed from the land, as against the small quantity of half a ton grown without manure.

That is to say, the bacteria are helped to life and multiply by their best plant, which is encouraged by the application of mineral manures, which are comparatively cheap. The host plant, in turn, is supplied with nitrogenous food by these bacteria which they get from the atmosphere for nothing, and the host plant, with its decaying roots, stems and leaves, supply stored up nitrogen to the succeeding crops. The value of leguminous crops as restorers of soil fertility apart from their value as food, can thus be greatly increased. The leguminous crops, without the nodule-forming bacteria, exhaust the soil of its nitrogen like any other crop. The fact has been very strikingly demonstrated at Rothamsted in the year 1905.

* See, *ante* p. 3, *et seq.*

It has been stated by Professor A. F. Woods of the Washington Bureau of Plant Industry, that this investigation does not stop with the nodule-forming organisms. There are other bacteria which have the power of fixing nitrogen from the atmosphere independently of any particular crop. It may be possible, when the life-history and habits of these species are fully ascertained, to improve, cultivate, and distribute them, as is done with tubercle forms. If this can be accomplished they will supplement the work of the tubercle bacteria, and will add greatly to the world's supply of stored nitrogen, which is one of its greatest sources of wealth.—J. J. Willis, in Journal of Horticulture.

THE SUPPLY OF NITROGEN

The International Congress of Applied Chemistry had a most successful meeting in Rome from April 26th to May 5th, 1906. According to a recent issue of "Nature," among the papers contributed the most important was undoubtedly Dr. Adolph Frank's description of his process for the direct utilisation of the nitrogen of the atmosphere for the production of artificial manure and other chemical products. Dr. Frank's invention is not only ingenious, but its effects on the future of the human race will probably be of the greatest importance. The inventor is a veteran in agricultural chemistry; he, it was who, more than 50 years ago, introduced the potash salts of Stassfurt to the notice of agriculturists. Now nearly three million tons of these salts are used annually by agriculturists all over the world. As regards the fixation of atmospheric nitrogen, the invention is not a complicated one. Calcium carbide is first produced and then heated with nitrogen obtained by the fractional distillation of liquid air. The first raw material obtained is calcium cyanimine, and it is this, that is used as a nitrogenous manure, numerous experiments having shown that the nitrogen which it contains can be easily assimilated by plants. For countries such as Italy, and more especially India, with large agricultural populations which do not possess sufficient cattle to supply the requisite nitrogenous manure, this direct utilisation of the inexhaustible nitrogen of the atmosphere cannot fail to be of enormous importance.

ELECTRICITY IN THE GROWTH OF VEGETABLES*

Accounts in the American Press of some exceedingly interesting electrical experiments in forcing the growth of vegetables, have apparently given rise to expectation of developments of incalculable value. In a large market garden at Arlington, Massachusetts, not only has the arc lamp been employed, it is said, with success in accelerating growth, but faint currents have been passed through the beds, with the result that their rate of production has proved to be distinctly more rapid than that of other beds under precisely similar treatment, except that the electrical experiment was not applied to them. To electrical students it is the method of inducing the current that will be most interesting, for it is reported that, after heating the soil for some purpose not clearly explained, nothing more is needed than to sink a copper plate at one end of the bed, and a zinc plate at the other, connecting them above ground by a wire, when a current could be measured varying from 0.4 milliampere to 15 milliamperes.

* *Vide* "Crops by Electricity," p. 23 *ante.*

THE SUGAR INDUSTRY*

India produces a vast quantity of sugar-cane and its annual raw produce is 50 lacs tons or 14 crores, the outturn of Bengal *Maumo* alone being valued between Rs. 60 and 70 crores. India is the original home of the sugar-cane and the soil is admirably adapted to its cultivation. In ancient history it is mentioned that, white-sugar was shipped to Europe in 500 A.D. and from that time onward the sugar industry gradually developed and mostly in Great Britain. All the production was the cane-sugar, till Napoleon Bonaparte blocked the way for British manufactures. The French people, being hardly pressed for want of sugar, invented a novel idea in manufacturing cheaper sugar out of the beet-root and since then the development has been very successful and it has marred the cane-sugar Trade. How many people are aware of the fact that it is full of impurities; animal bones and blood are its chief ingredients? About 60 per cent. of the world's supply of sugar is obtained from this source. The competition has been very keen and everybody looks for a cheaper stuff, but it is not advisable to use anything at the

* *Vide* on allied subjects, pp. 78-94 *ante.*

expense of the nourishment and growth of body as no one would care to shorten his age. It is a glad tiding to know that Mauritius, Java and West Indies are developing their own industries, but it is a pity to know that India is lacking behind.

If India takes to start such enterprise, there is likely to be a vast profit and such concerns would be very paying. Mr. S. M. Hadi of U. P., is of opinion that refined sugar must sell in preference to "gur" or unrefined sugar as that is always saleable and finds a better demand. The Bombay Agricultural Department show an average profit per acre from 100 to 150 rupees for "gur" but if the same production is converted into sugar, the profit would be 25 to 50 per cent. more.

As the "Marhatta" informs us— In Queensland (Australia), the latest information is that 1900 maunds of cane per acre was produced and yielded 320 maunds of sugar. The all-India average percentage is very low and reasons for the decadance of this industry are :—(1) Unscientific cultivation, (2) Defective method of extracting juice, (3) great waste in refining (4) The poor outturn of bad cane and of saccharine matter abnormally small.

Mr. Hadi's estimate for a factory to work up the produce of 300 to 500 acres within 6 months is Rs. 50,000 for machinery and building and Rs. 10,000 working capital. The following is an approximate estimate of receipts, and expenditure and profit of such a Factory :—

RECEIPTS

23,000 maunds of sugar at Rs. 10 per maund	2,30,000
20,000 maunds of "gur," 2nd quality "gur" at Rs. 3	60,000
Total Rs.	2,90,000

EXPENDITURE

Cultivation of 500 acres of sugar-cane including cost of making sugar, "gur" and other expenses at Rs. 500 per acre	2,50,000
Profit Rs.	40,000
Rs.	2,90,000

Thus a capital of 1,50,000 gives over 25 per cent. interest per annum. The expenditure calculated by Mr. Hadi is at the highest rate per acre.

It is anticipated that the Punjab will not lag behind in making progress and developing such industries upon which lies a good deal of our religion. The concerns like the Punjab and Kashmir Trading Co., Ld., ought to have started Sugar Factory in preference to other business already started, still it is not too late for them to start it now, if they have got sufficient capital to meet the preliminaries and its Directors

should make good effort to sell every share they have got left behind, and a great advance is likely to be made in the near future.

The following systems are being worked up in the successful countries, and it will give some idea to our promoters of the Sugar Industry:

(*a*) Plantation system—Agriculture, labour, factory and capital, is worked by a Syndicate or a Joint Stock Company.

(*b*) The Central Factory—There are companies that buy the materials from which sugar is obtained or hire the right to grow, as they desire, on the land of others.

The factories which they buy are called "Cane-purchasing Central Factories" and those that hire the land are called "Land-hiring Central Factories."

The Plantation system is considered the best. The cane-buying central factories and the land-hiring systems are in vogue in some parts of India, specially in the United Provinces.

The total amount of imported sugar is about one-tenth part of the enormous quantity of sugar of all descriptions annually consumed by the people of India, thus bringing the despair, not of being able to oust foreign-sugar from Indian market to a minimum. Now, that the public attention has been directed to the subject, we will find at no distant date, the foreign sugar is no more in the market. There appears to be no reason why all the sugar, consumed in India, should not be manufactured in India, and India made independent of beet-sugar. All that is necessary for the purpose is capital. Plenty of money now remains unproductive in the form of Government Securities, and jewel, and the enterprise will turn this capital to use.

RUBBER CULTIVATION IN BOMBAY*

Bassein Garden Experiments

A Press Note, issued by the Bombay Government, Revenue Department, contains some useful notes on the chief rubber yielding plants by Mr. G. A. G. Gammie, Economic Botanist to the Government of India, drawn up in regard to the scheme for rubber experiments in the Bassein Garden.

Mr. Gammie states that the India or Assam rubber-plant is to be found in damp forests at the base of the Sikkim Himalaya eastwards, the Kharia Hills, Assam, Burma and Perak, and the Malayan Archipelago. In experiments made

* See *ante* p. 96, and *Post* Part III. (Trade, Commerce and Industries.)

in the cultivation of this plant in Western India, propagation by cuttings and by "*gootee*" has given the best results so far. Planting at 35 feet apart is said to be sufficient, and this is the most suitable for Bombay. In Bombay a tree would probably be 25 years old before it is fit for tapping. As regards climate and soil, the tree naturally exists under a minimum rainfall of 70 inches, well distributed throughout the year and with the air perennially humid. Except in Kanara and the South Konkan, there are no conditions approaching this, so that in planting in other districts, the plants should be kept within reach of water.

The quality of the soil is not an important consideration, provided it be well drained. Arrangements have been made to put out a few specimens of this tree in the Bassein garden. There are already a number growing well in Thana. It thrives moderately well in the Deccan, in the vicinity of water, although its growth is very slow, and from an analysis made by Mr. Hooper, it appears that the rubber is of good quality. The Bassein garden, on the whole, offers a suitable site for this experiment. The unfavourable factors may possibly be the long period of dry weather with deficient humidity and undue proximity to the sea.

The Para-rubber-plant is obtained in the Brazilian Province of Para. It has been proved to adapt itself to various climates, and has been successfully grown at moderate elevations under a lighter rainfall. The trees require a fairly good soil in sheltered positions, and are hardy enough to thrive even on swampy flats in Brazil, but are said to develop poorly on similar soils in Ceylon and in districts where the rainfall is insufficient, the deficiency can be met by irrigation. The plant refuses to grow in the Decan, being killed by the low night-temperature prevailing in the cold weather. The best distance for planting is said to be 15 feet apart. The seeds are germinated in nurseries, and the seedlings sometimes attain the height of 10 feet in a year. Tapping is commenced when the trees are seven years old. The Konkan and Kanara in general seem to offer suitable conditions for the cultivation of this, the most valuable of the rubber-plants.

Experiments with the *Castilloa Elastica Rubra* or reddish bark plant have not proved very successful at Ganesh-khind, but there is no reason why the Ceara rubber plant, a native of Brazil, flourishing best in a dry soil and refusing to grow in wet land, should not be grown everywhere in the the Bombay Presidency. A recent analysis

of its rubber from plants grown in Poona by Mr. Hooper proves that the quantity is satisfactory.

As regards the proposed experiments in the garden at Bassein, a number of seeds of each of the following species and varieties have already been sown in pits 12 feet apart on a plot of well-drained ground :—*Castilloa Elastica*, *Hevea Brazliensis*, *Manihot*, *Glaziovii* [Kullar, Parson's black, Parson's grey, and Bekki Kolly varieties] and *Cryptostegia grandiflora*. A small number of plants of each of these varieties has also been planted out, 12 feet apart. A number of seeds are being germinated in pots, so that the plants can afterwards be tested under various conditions in different parts of the garden. Plants of *Ficus Elastica* will be put out during the rains. A few plants also of *Kicksia Africana* will be put out at the same time, although it is not considered practically useless as a rubber-producing plant. Seeds and plants of other species are being applied for, but the above are really all that will repay their trial.

GOVERNMENT LEASES OF LAND IN BURMA FOR RUBBER PLANTATION

It is notified that grants of leases of waste-land not exceeding 1,200 acres in area for the purpose of planting rubber trees may be made by the Deputy Commissioner of any district in Tenassarim and any other district specially notified by the Lieutenant-Governor of Burma. For areas exceeding 1,200 acres the applications will be submitted to the Financial Commissioner of Burma, with the recommendations of the Deputy Commissioner and Commissioner. The leases will be for thirty years, the lessee having a right of renewal for a further period of twenty years, and the land so leased, will be exempted from land-revenue for twelve years.

LEASE OF LANDS IN MYSORE FOR RUBBER CULTIVATION

It is under the consideration of the Durbar to encourage rubber-cultivation in the Province, and allot lands for the purpose to enterprising exploiters. With a view to decide the principle on which the land is to be allotted a committee has been formed, assemble to discuss the question. The Committee is composed of the Dewan, the two Councillors, the Revenue Commissioner, the Conservator of Forests, the Agricultural Chemist and the

Superintendent of the Botanical Gardens in Mysore, besides a few delegates from the Planter's Association.

TIMBER IN THE ANDAMANS

Tenders will shortly be invited for the purchase on a long lease of valuable timber, standing in the north and middle of the Andaman Islands. The annual output in log from these islands is estimated to be about 25,000 tons of 50 cubic feet, the produce of trees, varying from 6 to 12 feet in girth. The method of extraction involves the use of elephants in dragging the logs to the tidal cracks, whence they are floated to natural harbours, affording a safe anchorage to vessels of considerable size. The forests will be divided into annual felling areas, estimated to contain nearly an equal amount of the timber of the most valuable kinds; and the outturn may be removed either in the log or rough squared or sawn, as the purchase contracts may require. There are at present no roads or buildings for miles in the area which is covered with a virgin forest. A Government mail steamer runs weekly to either Rangoon, (about 1½ days) Calcutta (about 4 days) or Madras (about 4 days) from Port Blair. The estimated amount of timber to be removed annually is as follows:—

Red Padauk—(*Pterocarpus dalbergicides*) about 10,000 to 12,000 tons annually—a rich bright red wood deepening in colour on exposures—squares usually upto 200 feet in length,—siding upto 2 feet—weight 40 to 60 lbs. (dry) a cubic foot. This timber is largely used in America. It makes handsome furniture, panels, flooring and carving and takes a beautiful polish. It is generally suitable for the purposes to which mahagony, teak and oak are applied and it has been largely used for panelling in railway cars and for construction.

Albizzia Zebbek—about 500 tons annually—wood greenish grey to chocolate in colour ; makes handsome furniture and carvings plain or polished—squares upto 20 feet in length—siding up to 2 feet—weight 45 to 50 lbs. (dry) a cubic foot.

Gurjan—(*Lipterocarpus turbinatus*) about the same quantity as Padauk. This wood is suitable for wood-paving and for sleepers ; squares up to 20 feet in length—siding up to 1 fit 6 in.,—weight (dry) 45-55 lbs. a cubic ft.

Pyinma—(*Lagerstromia hypolenca*)—about 200 to 300 tons annually ; colour pale reddish grey ; squares up to 20 feet—siding up to 1 ft. 6 inch—useful for boat-building, planking, etc ; weight (dry) 48 lbs. a cubic ft.

White Chuglam—(*termiualir bialata*)—about 600 to 700 tons annually; colour light grey with dark markings; weight 48 to 58 lbs. (dry). Makes handsome furniture and takes fine polish; squares up to 20 feet in length—siding up to 2 feet. Black siding up to 2 feet.

Black Chuglam—(*myristica irys*)—about 400 tons annually; colour similar to white chuglam but darker; weight 50 lbs (dry)—squares up to 20 feet; suitable for cabinet-work.

In addition to the above, there are several other less valuable timbers available in varying quantities. All the above timbers float in sea-water and the cost of extraction from forest to the harbour, is estimated at from Rs. 14 to Rs. 16 per ton. No labour is available in the Island, but it may be imported from Madras at a moderate cost.

Further information may be obtained from the Inspector-General of Forests to the Government of India.

FOREIGN FLAX*

Some of the Behar planters have already cultivated foreign varieties of flax plant for fibre on a small scale with great success and it is mainly at their suggestion that the seed-stock is being imported. A small factory is at present working.

Arrangements have been completed by the India Office for the early despatch to Calcutta of ten tons of Russian and Belgian flax seed, of the best quality obtainable, for experimental cultivation in India.

NEW JUTE LANDS IN ASSAM*

A correspondent writes to the *Indian Trade Journal* to say that along the line of the Assam-Bengal Railway in Nowgong District, there is excellent waste-land on the right-bank of the Kopili river, and it appears this land is suitable for jute-cultivation. Perhaps it is not generally known that a few Dacca families have settled down further west than this point, and have grown jute for some years. If a few Jute Mill Companies combined, and, as an experimental measure, obtained a grant of a few thousand acres of land and settled Dacca or Chandpur families there, the Jute Mill Companies supplying the capital and dividing the profits in some equitable way with

* See *post* Part IV.—The Fibre Industry.

* See *post* Part IV.—The Fibre Industry.

the cultivators, there is reason to believe, they could get their jute for Rs. 5 a maund, and it would pay both parties handsomely. A start might be made with Rs. 50,000; this would enable the requisite number of families to be settled there, and would supply them with bullocks, ploughs, seed and food for the first year's operations. The scheme requires working out, but with the assistance of a good agriculturist acquainted with zemindary affairs, a very perfect scheme could be drawn up. If this scheme became a success, every mill in the country would have a certainty to fall back upon, and prices would be steadied.

PART II.

MINERAL PRODUCTS AND PROSPECTS

MINERAL PRODUCTION IN INDIA

Result of the Past Decade

Mr. R. E. Enthoven, Offg. Director General of Statistics, has issued the following statistics of mineral production in India in the ten years, 1893 to 1902.

Salt

The production of salt in India averages about a million tons annually, fluctuating from time to time with the seasons. Last year the production was 1,099,391 tons. In 1900 the production at the Sambhor lake was extremely small, but with a better season, manufacture in 1901 was very active. The level of 1901 was, however, not maintained last year. The largest proportion of the salts produced in India is, however, sea-salt made on the coast in Sind, Bombay, Madras, Burma, and Aden. The quantity so made on the Indian Coasts in 1902, represented more than two-thirds of the whole production.

Coal

The output has increased from 3,540,000 tons in 1895 to 7,424,500 tons in 1902.

Coal is found of varying quality over a very extensive area of the Indian region. At present, the principal mines are located in the Raniganj, Jherria, and Giridih coal-fields in Bengal, at Singareni in the Nizam's Territory, at Makum in the Lakhimpur District, in Upper Assam, at Mohpani and Warora in the Central Provinces, and at Umaria in the Central Indian Agency.

Indian coal is now extensively, in some cases exclusively, employed for the railways, coasting and river steamers, mills and factories; but, as in the case of salt, the conditions of transport are not yet sufficiently developed, though they are being greatly improved, to permit of the exclusive use of Indian coal for industrial purposes. The quantity of Indian coal used in India, is, therefore, supplemented by an importation which has averaged 267,000 tons annually in the last five years. Imported

coal is mostly landed in Bombay, the mills in that place requiring large quantities of fuel and being too remote from the Indian sources of supply to find the use of Indian coal economical, having regard to the easy conditions on which steamers carry coal to India as freight. Most of the imported coal is English, a small quantity being received also from Japan.

Gold

Gold is produced mostly in the mines of the Kolar District in Mysore, where the annual output now exceeds half a million ounces. From the mines in the Nizam's territory, only a small quantity was extracted until 1903. Recently, arrangements have been made with a view to re-opening old gold mines in the Dharwar District and the Sangli State of the Bombay Presidency. No account is taken in these tables of the gold produced in the parts of Northern India from the washing of river-sand; it is well known that it is insignificant, but there are no means of stating the quantity statistically.

The aggregate reported production is 517,639 ounces, the value of which may be taken to represent, at £4 an ounce, about two millions sterling. It is all shipped to London.

Petroleum

The production which is confined to Burma and Assam amounted to nearly 57 million gallons in 1902, more than 54 million gallons being of Burman production. Although the production has expanded very largely, it is still insufficient for the requirements of the Indian market, which are met by the importation of some 81 million gallons from the United States and Russia. The exports of Burma petroleum in 1902-03 were :—

Foreign countries .	21,400	gallons.
Indian ports......	20,704,389.	,,

It should be borne in mind, however, that the Indian production is stated in terms of crude petroleum, while the imports consist of kerosene and lubricating oil.

Saltpetre

This article, which is largely produced for export, was in former years of much greater importance than now, the decline in demand for gunpowder and the preservation of food with the competition of the nitrates, having operated to prevent any expansion of the exports. It is most largely produced in Behar, whence the article is sent to Calcutta for export after refinement. The average production in Bengal, that is, in Behar, is stated to amount to only about 222,600 cwt.

But the production is grossly understated, for the average annual exports of refined saltpetre from Calcutta, in the last five years, have amounted to 269,444 cwt. and this represents a much larger quantity of crude-saltpetre.

Iron

The production of iron is as yet in its infancy, the ore being worked for the most part only in the Raniganj District of Bengal, where it occurs in close proximity to the coal-field. According to the figures, which, however, are of doubtful accuracy, the production in 1902 amounted to only 80,869 tons of which 76,056 tons were produced in Raniganj. The adequate utilisation of the iron of Bengal and other parts of India, involves the application of very large capital for the manufacture of wrought iron and steel, in the forms in which these metals are mainly used in India. The cost of fuel is also a difficulty in places where coal-fields are remote. Efforts are being made in Western India to overcome these difficulties and to start experimental workings of certain rich iron ores in the Central Provinces.

Graphite (*Plumbago*)

In the State of Travancore, there are three mines from which graphite was extracted in 1902 to the extent of 4,575 tons. No information has been given of the quantity of the graphite. It is doubtless exported; but no particulars of the trade have been furnished, nor are the capabilities of the mines known. A trifling quantity 9 cwt. of plumbago was extracted in 1902 from the Ruby Mines in Burma.

Other Minerals

These are relatively of small economic importance, Manganese ore, mica, and tin-ore alone being of commercial importance.

The production of Manganese commenced a few years ago, the product being shipped to England. India now ranks second or third amongst the Manganese-producing countries in the world. The high quality of the ores in the Central Provinces permit their export in face of a railway journey of over 500 miles, and a heavy sea-freight to the European and American markets. This limits the production to the better grades.

The extraction of mica has been an industry in Bengal for a considerable period and recently this mineral has been worked in Madras in some quantity. This was also mainly exported, the exports last year being 1,021 tons valued at about 13 lakhs.

Tin-mining has been operated for many years by the Chinese in Lower Burma, but their operations have not indicated any tendency to expand and the trade is

trifling. It is practically all used in India.

GOLD IN THE KALAHASTI
(An Estate near Madras)

AN EXPERT'S REPORT

SOME PROMISING MINERAL DISCOVERIES

Mr. V. S. Sambasiva, Iyer B. Sc., I.C.E., F.G.S., Curator of the Mysore Geological Museum, and an officer of the Mysore Geological Department, has drawn up a most interesting and valuable Report on the Mineral Resources of parts of the Kalahasti Estate, near the city of Madras. He summarises his discoveries as follows: —

General Geological Features

The tracts of the Kalahasti Zemindary that were traversed are shown on Plates I and II and the general lines of communication to those parts on Plate III.* The rocks noted during these rapid marches are granites and gneisses, the Cuddaphas and some hornblendic and chloritic schists. Considered from an economic point of view, each of these groups is of some value. The granites of parts of the Pamur Division round about Garimenpeta bear numerous but comparatively small string and patches of hornblende schist. holding some ores of copper and the granites themselves show occasional stains of malachite. The basement beds of the Cuddapahs enclose fragments of iron-ore schists, and quartzites, suggestive of their derivation from a ferruginous schist—probably the Dharwars.

"Gold-Hill"

The assay of a random surface-sample of the basement-bed showed a trace of gold, while *Kanaka-durgam*—Gold Hill, formed of the Cuddapah rocks, yielded a grain of pan gold. The name of the hill and that of the river *Suvarna-mukhi*—gold faced, are very suggestive. The two local traditions regarding the hill and the river, as detailed above, contribute their share of giving some importance to the rocks of the Cuddapah formation in this region, if the reputed occurrence of gold in the river be not due to its crossing an auriferous schist-belt of the Dharwar system, nearer its mouth than its source. The large developments of the basement beds of the Cuddapahs in the regions drained by the *Suvarna-mukhi* to the south-west of Kalahasti, become a source of additional importance, if at all,

* We regret we could not reproduce these plates.—*Ed.*

there be any. The extensive deposits of the single beds of that region should also be reckoned and all these areas must be fully examined for gold with the help of a jalagar. The occurrence of these rocks in the Pamur Taluq is very subordinate, compared to that in the Kalahasti Taluq, and yet they may be similarly examined for gold. It may be noted here that they directly overlie some hornblende schists as near Ruttalur.

Beautiful Pink-Marble

Several belts of basic schists were also noted during the traverse. A building-stone and an earthy mineral are the minor minerals of economic value found in these schists, besides iron-ore and gold. Flesh-coloured and dull-white marble of medium to coarse grain and of a homogeneous aspect, constitutes the building-stone. Its homogeneous fleshy colour, large quantity and proximity to a good road leading to a Railway Station, 27 miles off and to canal, eight miles further, constitute some of its advantages, from a commercial point of view. The high price paid for similar stones in the U. S. A., at Rs. 6 to Rs. 9 per cubic foot, also add to the value of the deposit. Architects and sculptors in Madras, Calcutta and Bombay may be consulted as to the forms and sizes suited to the markets there.

Other Minerals

The thick-spread of large nodules of more or less white Kunkur lime-stone in the area between Kottapette and Utakur may be tried in cement manufacture. The earthy mineral referred to above is barytes, occurring as irregular veins in a highly weathered basic-rock, which passes locally into bands of lime-stone. Its commercial value will depend upon its quantity, which is yet to be ascertained by tracing the parent rock and opening it out at suitable points. Iron ore noted at Sirasinambedu occurs in large quantities, no doubt, but there is no immediate importance to it, as there is no demand for such in those parts and all the old smelting-furnaces were closed several years ago.

Further Gold Indications

Of the belts of basic schists found during the exploration, two patches occur near Gandipalium and Krishnampalle and appear to be continuations of those between Udayagiri and Duttalur. The S. E. continuations of these latter may be looked for round about Rachevarpalle and Gandieved. The schist-belt south of Utakur and that beneath the black cotton-soil, if any, on either

side of Pamur should be tried for gold, as well as the others mentioned above. The specks of gold found near Adimurtipuram and west of Lingasamudram do not appear to me to signify much. The rocks and the associations are not quite favourable.

A Gold-Belt of Real Value

The Sirasinambedu schist-belt to the N. E. of Kalahasti is the only auriferous band of real value, discovered during this traverse. It presents unmistakeable evidences of its auriferous nature. The formation is quite favourable, as it belongs to the Dharwar system, which is the only source of gold in S. India so far known, all the auriferous tracts in this part of India being found to be situated on the rocks of this system and all attempts on other rock having proved futile from an economic point of view. The dark hornblende schist forms the main mass of the belt as in the Kolár Gold Field. There are likewise three unmistakeable large old workings for gold on this schist, with big dumps round in site of their position on the steep hill slope and of their age. Every panning of the scrapings from the sides of two of these shows numerous but very fine grains of gold of very rich colour. There is also a tradition that these pits were dug up for gold. These pits will have to be opened up and the reefs that were followed by the ancients, will have to be found and numerous assays made of the quartz of those reefs, before a correct estimate can be formed of the exact value of the gold mine. The evidences obtained so far fully justify a detailed prospecting of the area and a deep prospecting of this particular tract near Sirasinambedu, containing the old workings for gold. This schist-belt is very probably of a greater extent than is actually visible as out-crops near Sirasinambedu and Palachur. This point will have to be ascertained, the Cachinad Taluq also examined for a possible occurrence therein. of any belt of schist of the Dharwar system.

This discovery of the Sirasinambedu auriferous belt fully justifies further work being undertaken on the various lines suggested in this Report.

GOLD IN ASSAM

Gold-dredging operations are also about to be undertaken in Assam, where, it is believed, the rivers of the Lakhimpur District offer possibilities which are worth exploiting. The district authorities have granted a license for the purpose.

GOLD IN BURMA

Burma was upto now only famous for its rubies, but now it appears there has been found gold also. The samples of gold-quartz found in the Mongpan State, one of the many divisions of Upper Burma, have been forwarded to the Government Geological Department in Calcutta for examination. We hope, the quartz will be found very rich in gold, as according to the Hindu Mythology, Burma was the kingdom of Indra, the king of gods and goddesses, the streets of which were strewn with gold-leaves and the jewel-bedecked houses were built with bricks made of this precious metal.

GOLD-DREDGING IN UPPER BURMA

Some interesting information is given in the *Indian Trade Journal* of gold-dredging in Upper Burma. It is stated that dredging for alluvial gold was begun at Myitkhina on the Irrawaddy at the end of 190?, the company concerned in the enterprise, employing a dredger capable of dealing with 10,000 tons per week. They had a grant of 150 miles of the river, and they were so satisfied with the results that, last year, they employed two dredgers. The value of the gold won in 1905 was just over Rs. 39,000, but, it is added that, the work has progressed little beyond the stage of prospecting. A few years ago, it seemed as if alluvial-gold would be found in large quantities in Upper Burma, as a gold-mine at Kyaukpazat, near Wantho, was giving good returns. But in 1903 the pay "chute" was lost and it has apparently not yet been struck again.

GOLDFIELDS IN HYDERABAD

The returns of the Hutti Mines in the Nizam's Dominions for the month of June, 1906, are as follows :-- 2,100 tons of quartz crushed produced 903 ounces of gold ; 2,050 tons of tailings, cyanided produced 280 ounces, in May. The first report of the Topuldodi Nizam's Gold Mines shows quite a substantial amount of work done, with results distinctly encouraging. Ancient workings of a most extensive character have been found, and Mr. Grey, the General Manager in India, is convinced that the quartz was of high grade. The fact that the old workings were at least 250 feet deep on the underline of the lode, which, in those days, would have been regarded as deep-mining, is of itself quite sufficient reason for

prosecuting the explorations with the utmost possible vigour. It is proposed to send out at once an air-compressor plant for driving the rock-drills. Mr. Grey concludes his report with the statement that he has every confidence in the future prosperity of the Company. Mr. Grey, having put in 24 years' service in India, is returning to join the Board at home. He is succeeded in the Hutti Mine by Mr. W. S. Thomas; Mr. Prideaux, Mr. Grey's assistant in Hatti, takes charge of the Topuldodi-Mine.

THE KOLAR GOLDFIELDS

The Study of Foreign Methods

Dr. W. F. Smeeth, the State Geologist and Chief Inspector of Mines to the Government of Mysore, now on furlough, has been permitted by the local authorities to receive a sum of 500 guineas from Messrs. John Taylor and Sons for services rendered to the Kolar Goldfields. The Mysore Government have sanctioned the payment of £500 to Dr. Smeeth to go to Norway to learn the electrical treatment of iron, to South Africa to study the system of deep-level mining, and to Canada to acquaint himself with copper mining.

The report of the Mysore Mine for the past twelve months is quite an unique one, surpassing all previous records for the past 25½ years. As is justly remarked by the Superintendent, it is a "record of remarkable progress and successful development." The reserves of ore increased last year from 380,000 tons to 613,000 tons. The mills ran without serious interruption during the year, crushed 195,650 tons of quartz for a production of 184,957 ounces of bar gold and treated 165,491 tons of tailings, resulting in an extraction of 20,432 ounces of gold. By these two processes, a total quantity of 205,389 ounces of bar or 207,049,671 ounces of standard gold was obtained, which realised after the deduction of royalty, the sum of £764,587 5s. 6d. A heavy outlay has been incurred in connection with the new works to keep pace with the growing demands of the great undertking which the Mysore Mine has now become, and it cannot be questioned that the prospects of the mine fully warrant extra expenditure. It is, therefore, deemed necessary that further working capital should be provided.

WORLD'S OUTPUT OF GOLD

The world's yield of gold in 1905, in actual output, passed all precedent, but, a single gold-field in South Africa, was practically responsible for the year's advance. Outside Africa, although the demand for gold was active, the world's gold producers did not contribute anything like a large amount. The total yield is calculated at 18,211,419 ozs., valued at £77.358,466, compared with 16,739,448 ozs., valued at £71,105,825 in 1904. To last year's total, Africa contributed 5,495,473 ozs. Australia in 1904 was second in production, but in 1905 it surrendered its place to the United States, which totalled 4,219,280 ozs., Australia producing 4,155,138 ozs. The only other large producer is Russia, which has long held the position of fourth in yield. For last year, it output was 1,100,000 ozs., a loss of about 100,000 ozs. compared with 1904, due to the disturbed state of the country. The two most important points indicated by these figures are: (1) That the world's output is not as limitless as many seem to think; and (2) that last year's addition was due to new developments, and not to the growth in yields of the old producers.

INDIAN PRODUCTION

According to official statistics, the production of gold from the mines in India, for the month of November, 1905, was as follows:—

Balaghat ...	3,744	ounces
Champion Reef	15,491	"
Mysore ...	15,206	"
Nandidrugh	4,970	"
Urigaon ...	4,679	"
Elephant ...	84	"

Most of the mines are owned by foreign capitalists.

EXPORTS AND IMPORTS OF GOLD AND SILVER

The total quantity of gold imported into British India from foreign countries in the month of April, 1906, was 147,287 ozs., valued at Rs. 92,50,868. The quantity of gold exported amounted 114,174 ozs., valued at Rs. 66,07,484. Of the imported gold, 116,795 ozs., valued at Rs. 74,53,460, consisted of bullion, whilst of the remainder 25,943 ozs., valued at Rs. 15,28,178, represented sovereigns and other British gold-coins. Of the exports, 31,263 ozs., valued at Rs.17,59,484, represented bullion, British gold-coin being represented by 82,208 ozs., valued at Rs. 48, 07,500. The total imports of silver amounted to 11,533,557 ozs.,

valued at Rs. 2,30,72,357, of which 10,543,315 ozs., valued at Rs. 2,11 78,398, represented bullion, and 82,026 ozs., of the value of Rs. 2,18 977, represented Government of India Rupees. The total exports of silver amounted to 1,360,631 ozs. valued at Rs. 36,27,466, of which 1,358,531 ozs., valued at Rs. 36,22,750, represented Government of India Rupees; and 1,077 ozs., valued at Rs. 2,640 British dollars, the remaining 1,023 ozs., valued at Rs. 2,076, consisting of bar and other kinds of uncoined silver.

GOLD-MINING COMPANIES

The distinction previously held by the 'Simmer and Jack' of being the greatest gold-producer in the world, has during the past few months been attained by the 'Esperanza' of Mexico. Not only in the output but in profits, the latter Company easily leads; but, share-holders have been officially advised not to place too much reliance upon the permanent maintenance of these results. It is this inconsistent element which is in the essential difference between the properties of the Rand and those of other big gold-fields. It is impossible to estimate ahead, with some approach to accuracy, what the output will be of a Rand mine, with the addition of so many more stamps. For instance, the 'Angelo,' now earning £200,000, per annum, should, with the increase in its stamping power, secure profits of £450,000 per annum. The 'Cason,' which is being equipped with 220 stamps and tube-mills, should earn £400,000 per annum; while the 'Nourse' mine should increase its annual profits from £220,000 to £410,000. They are likely, with the 'Simmer and Jack' and 'Robinson,' at present earning £360,000 and £552,000 per annum respectively, to be the six great mines of the Rand, during the next two years.

DIFFERENT MINERALS IN INDIA

Information is furnished asto the existence of mica, copper-ores, manganese, rutile, garnet, kyainte, limestone and marble in the Narnaul District. For mica the principal localities are said to be Ghatasher, Saraili, Panchnanta and Musmuta, covering an area of about 14 square miles. The mica occurs in lenticular veins and mica "books" obtained attain a size of 9 in. by 6 in. Asto copper-ores, they are said to be very widely distributed, and that they have been extensively worked in past times, is evidenced by the

large number of mines scattered throughout the district. The ores are said to be most numerous in the southern portion of the district. The manganese-deposits which occur about Goela, Dargaka, Nangal and other places are said to be of some commercial importance, but their distance from the Calcutta market renders the prospect of their exploitation rather remote. Rutile is believed to occur in some abundance in the Aravali-series and garnets are also reported to be rather plentiful in the hills east of Ghatasher, though the colour is said not to be sufficiently good to render them marketable. The kyainte obtained in the district, fetches from Rs. 3 to Rs. 5 per tola, according to the testimony of the Patiala jewellers. Limestone and marble are said to occur in great profusion and variety in the district. The black lime-stone is said to have a high reputation in the Delhi market, where it sells at the high price of eight annas a maund. White and black marbles occur in several localities and quarries are being worked in some of them.

THE TATA IRON AND STEEL COMPANY

With regard to the Tata Iron and Steel Scheme, prospects are now declared to be satisfactory. We understand that the capital of the proposed company will be about 113 millions sterling. A prospectus inviting subscription to this, will be issued simultaneously in London, Bombay, and Calcutta. The works will be erected at Sini on the Bengal Nagpur Railway, and the plant, in the first instance, will be laid down to turn-out 120,000 tons of pig-iron yearly, of which 70,000 tons will be made into steel. The main feature of the undertaking will be the manufacture of steel-rails for Indian Railways, the demand for which is large and continuous. Ore which is of the finest quality can be obtained from the range of Hills at Gurumaishini, some fifty miles from Sini, and the Government of India will build a railway to the mines. Lime-stone may probably have to be brought from Kutni, unless deposits are discovered nearer a hand. An abundant supply of coal will be available by rail from the Jherria fields. It is expected that the plant will be in working order three years hence. Colonel Stoddart, who is Chairman of the syndicate connected with the scheme, returns home shortly to arrange for floating the Company.

IRON-ORE IN MAYURBHANJ

Messrs. Tata & Sons' Scheme

No less than 88 per cent. of the iron-ore raised in India, is mined in Bengal, and it is mainly utilised by the 'Barakar Iron and Steel Works.' In the Central Provinces, native iron-melting on a small scale, still shows signs of vitality, but the total Indian production in 1904, was only 71,608 tons of ore; in fact, the vast iron-ore deposits of the country are as yet untapped.

The experiments in which two American experts, brought out by the late lamented Mr. J. N. Tata, had so long been engaged, have given most satisfactory results. At present, only the 'Barakar Iron and Steel Works' are in the field with up-to-date appliances. These utilise most of the 88 per cent. of iron-ores raised in Bengal, out of the total out-put of Indian mines which amounted to only 71,608 tons in 1904. In his report on mineral production, Mr. Holland states that, rich ore-bodies have been determined in the Mayurbahanj-State, Orissa, and as the result of work conducted by Messrs. C. P. Perin and C. M. Weld on behalf of Messrs. Tata and Sons, it has been decided to erect iron and steel works at Sini on the Bengal Nagpur Railway and to use the Mayurbhanj ore, in conjunction with fuel from the Jherria coal-fields. The news must cheer up every patriotic heart.

DISCOVERY OF IRON ORE IN THE PATIALA STATE

A very important deposit of iron-ore occurs in the Narnaul District of the Patiala State. Mr. P. N. Bose of the Geological Survey, who was sent to report on the geology of the district, states that the richest and most extensive ore-body is to be found in a low-ridge which runs from Chapra, seven miles south of Narnaul to Jaunpur—a distance of two miles and a half. An analysis of an average sample made by Dr. Schulten indicates a high-grade ore; and, Mr. Bose adds, there is an enormous extent of it. The ore, occurs as bands interbedded with marble and schistoic rocks. It appears that, at one time, the ore was in great request in the neighbourhood and used to be carried far into Jaipur and Alwar State. There is not a single furnace now in the area. The chief obstacle, Mr. Bose thinks, in the way of exploiting all this wealth, is the absence of suitable coal any nearer than Bengal. At the same time the freight on coal for long distances has just been reduced and further

reduction may be expected in the future. "Besides, iron-works in the Punjab would command the markets of that Province and of Rajputana and the United Provinces. But I doubt, if iron works on a large scale, are likely to be started in the Punjab in the near future, since such works require very large capital, and since a company is now being floated with a capital of two crores of rupees to work the iron-ores of the Mayurbhanj State, which are similar to those of Narnaul, but are more favourably situated in respect of coal." But in any case, such extensive ore deposits, cannot remain unutilised for ever, and a similar activity to that which characterises Barrakur, must sooner or later be displayed at Narnaul.

MR. HOLLARD ON EXPORT OF RAW ORES

An example of the loss occasioned to India by the export of raw metalliferous ores is quoted by Mr. Holland, Director, Geological Survey of India in the January, 1906, number of the records of his department. It seems that the value returned for chromite, a mineral which is now being mined regularly in Baluchistan, is 23s. per ton, whereas its price at an American or European port is about £3-15s. That its worth in this country is not higher, is due to the rudimentary condition in which metallurgical industries of India now find themselves.

PETROLEUM IN INDIA

The production of petroleum in India during 1904 was 118,491,382 gallons (of which the production in Burma represents, 115,903,804 gallons) compared with 87,859,096 in the previous year. The rapid increase in production has naturally displaced some of the imported foreign-oil, of which only 70,590,858 gallons were introduced against 76,361,579 gallons in 1903. The reduction has been entirely on Russian oil, which fell from 65,434,324 to 42,266, 738 gallons. At the same time, there has been a remarkable increase in the exports of petroleum from 747,834 gallons in 1903 to 3,787, 677 gallons in 1904.

The Burma industry, with its remarkable expansion, has naturally affected the imports of foreign oil into India, the total quantity of which declined from 76,361,579 gallons in 1903 to 70,590,858 gallons in 1904. The reduction has, however, been entirely in Russian oils, there

having been a marked increase during the same period in the imports of oils from the Dutch East Indies. At the same time our own exports of petroleum show an increase from 747,834 gallons in 1903 to 3,787,677 gallons in 1904.

GROWTH OF BURMA'S OIL INDUSTRY

Some remarkable figures are published in the "*Indian Trade Journal*" regarding the imports of kerosene oil into India. In 1896, Russia and the United States had practically the whole of the trade in their hands, the former country sending about 45½ million gallons being imported, while American oil had sunk to some 5 million gallons. From that time onward, however, Russian imports steadily declined, and in 1905, they sank to under 8 million gallons, mainly owing to the anarchy at Batoum and the resulting destruction of the oil-works there. There had been no revival of trade with America in the intervening period, but last year, India took over 22 millions of gallons from the States. The reason of the displacement of Russian and American oil is chiefly to be found in the development of the Wells in Burma. In 1896, only 40,000 gallons of kerosene were shipped from Rangoon to India; in 1905 the quantity was 47 millions. Borneo and Sumatra have also come in for a fair share of the trade in the last few years. The oil industry in Burma is a notable example of the rapid expansion of a new industry. Ten years ago, the total production of the wells was less than 15 million gallons annually: now it is about ten times that quantity. Prices of kerosene have varied a great deal in the decade, but have lately declined, owing to competition. The highest point was touched in 1901, when the 'Victoria Brand' from Burma fetched Rs. 3-11-5 per case of two tins: last year the average was only slightly over Rs. 2-12-0. Even at these lower rates the trade is a very profitable one.

SALTPETRE

Saltpetre is an article which was once very much in use throughout the world for making gunpowder. Though by the invention of dynamite and other more deadly explosives, which are made from other materials, saltpetre is not any longer much used for that purpose, other various uses have been found for this article and

the demand has remained equally great.

This is an article, looking very much like salt in crystalised form, and has a peculiarly bitter-taste. A pile of white and well-refined saltpetre looks, from distant, exactly like a pile of salt, only it has crystals in it which are not found in salt. But all saltpetre is not of white-colour. It has all different colours from grey to perfectly dazzling white. The colour depends upon the nature and proportion of impurities, which generally are—potash, sodium and other admixtures, which, if allowed to remain in it, make it look muddy. Colour affects but little as to its usefulness, so far as gun-powder is concerned, but for other uses, the colour is required to be white. Very large quantities of this substance are exported to Europe for making crystal and glass-beads and other things of luxury. For these purposes, white colour is absolutely necessary, and the makers of these articles always gladly pay higher rates.

Saltpetre of inferior kind, containing greater salt but white in colour, is very largely used in America and other countries for preserving meat and very large quantities are exported every year from India. There are several other uses of this article and very large quantities are shipped to all parts of the world.

This most useful article, which is composed chemically of three ingredients, namely,—Potassium, Nitrogen, and Oxygen, is chemically known as *Potassium Nitrate.* The impurities which are generally found mixed in it, are due to the defective or negligent way by which it is prepared in the most primitive style in the country.

The process of making saltpetre is very simple. The manufacturers scrape out the earth of certain places, known to be Saltpetre yielding, which they put over fire in big iron caldrons, which are permanently fixed upon a hollow made in the ground, sufficiently big to admit a large amount of wood and coal for a fire sufficient to make the water boil. When boiling, they gradually take out the impurities as they come to the surface by the action of the heat, and continue the process until they find that sufficient has been taken out to make it of the standard of refraction required.

There seems to be a good scope for organised scientific enterprise in this direction.

CHROMITE ORE IN BELUCHISTAN

A Promising Industry

A Mineral industry in India, with apparently great promise before it, is the exploitation of the chromite-deposits in Beluchistan,

which were discovered only so recently as 1901. These deposits did not commence to be worked till 1903, when 284 tons were obtained of the mineral; in 1904, however, the quantity of ore raised went upto 3,596 tons of the value of £4,137, a remarkable advance within the period of one year only. At present, the ore is being raised entirely for export to Europe—the principal concessionaire being an English Syndicate;—but, it is believed, that the spread of the chrome-tanning industry, now being organized in Madras, should create a local demand for large quantities of chromic-acid. The area of these chromite-deposits, at present being worked, aggregate some 820 acres, of which 660 acres are in the Quetta, Pishin District and 160 in the Zhob District.

MANGANESE AND CHROMIUM

Prospecting Licenses in Mysore

The Mysore Government have modified the terms of perfecting licenses and mining leases, particularly with regard to manganese and chromium, in a way that should give a fillip to private enterprise. This is one among quite a variety of instances of changes that show a determination to open the province up and to encourage private enterprise to take a full share in the work of developing Mysore's resources.

MANGANESE ORE DEPOSITS

The survey of the known manganese ore deposits in India, recently carried out by the geological authorities, is said to show the existence of ore in quantities sufficient to meet the large export-trade in the richest varieties for many years to come, and of practically unlimited quantities of lower-grade, which, at present, price, would not pay for the high transport-charges to Europe and America, but would be available for the requirements of steel manufactures in India.

MANGANESE INDUSTRY

A Karnatak correspondent writes to the *Indu Prakash*:—"I have received the report of the manganese industry in Shimoga District of the Mysore State and will to-day give some idea about it to your readers. A gentleman, by name Mr. Hamilton Holmes, was able to start a Company, assisted by Messrs. Eardly Norton, Haji Ismail Shett and many others, to work up the

Shimoga Manganese Mines. Steel is manufactured in England from manganese and owing to the close of manganese mines in Russia, Indian mine-ores are now much in requisition in the English markets. The Shimoga District being very rich in manganese, the Company is, it is expected, making a very large profit. It has sent 1,500 tons of ore to Marma Goa harbour. It is said that the cost for each ton of ore, from picking at the mines to delivering at Marma Goa, is not more than twelve Rupees; but, the net-profits on each ton exported, do not amount to less than thirty Rupees. Nearly 300 cart-loads, carrying 150 tons, are daily carted to the Railway Station. This will give an idea of the extensive profits made by the Company. Special-trains are leaving daily loaded with manganese. Four more Europeans have obtained prospecting licences in this District. But no native has secured any block. There is a danger of the Shimoga District being Europeanised like the Kolar District, and, therefore, the new Dewan will, I hope, prefer native capitalists and agency to Europeans. In Khanapur Taluq of the Belgaum District, there are, I am told, good manganese mines and these have been obtained by Dr. Boyce and Mr. Mugashet, from Government."

MANGANESE ORE PRODUCTION

India's Rapid Advance

Although manganese ore mining was started in India some thirteen years ago, it is only within the last three years, says a correspondent of the *Times of India,* that the exports of ore have reached a figure of any magnitude. So rapidly, indeed, has the industry advanced within this period that India now ranks second in the list of manganese ore-producing countries, and it is confidently expected that the exports, for the present year, will not fall far short of a quarter of a million tons.

This state of affairs has been brought about by three causes—*(i)* the largely increased demand for the mineral in the manufacture of a specially prepared steel, *(ii)* the falling-off of the Spanish supply, which, for many years, had stood at 100,000 tons, annually, and *(iii)* the troubles in Russia and the consequent closing of mines in that country. The two first causes are likely to remain,—in fact, the tendency of the first will be to increase, as time goes on; but, the Russian industry is bound, sooner or later, to make its effect felt in the Indian market.

In the first place, the Russian, as far as freights to Europe and

America are concerned, has a very decided advantage. Then again, owing to the absence of steel-foundries in India, only high-grade ore is used, that is, ore yielding at least 50 per cent. mineral. The lower grades do not pay to export, and are consequently left undisturbed or dumped in the tailings. In Russia, on the contrary, the inferior ores can be disposed of to the various manufactories in that country, and, the lamentable waste one sees in Indian mines, is thus avoided.

The Brazilian manganese ore trade, which is developing very rapidly, will also undoubtedly affect the Indian market, especially in regard to the American demand, and possibly, with the numerous subsidised German steamship lines, trading between Germany and South American ports, the German also.

At present, mining operations are confined to the Madras Presidency, the Central Provinces, Central India, and Morma Goa, in Portuguese India. The Government of India Survey Department, who have just completed an exhaustive survey of the known deposits, report very favourably both as regards quality and quantity of mineral available in these regions. So far, the term mining can hardly be applied to the industry, as, with the exception of a deep cutting at Kamptee in Nagpur, all the working are surfacial,—mere quarries in fact. This probably is due to the fact that the present demand for ore is very great and that on new properties, this is the easiest way to obtain it expeditiously, and also possibly to the disinclination, on the part of the owners, to spend large sums on expensive plant at so early a stage of the enterprise.

The method of working varies on the different properties. At Kajlidungri in the Yabua State, Central India, outside labour has to be imported. This is mainly due to the aversion of the local *Bhils* to work seven days a week. Whole families are brought in, mostly from Ajmere and Ahmedabad, and are paid at so much per 100 cubic feet of clean mineral; and, without working over-hard, a man can earn as much as seven annas per diem, while a woman can earn half this sum. Children receive a lesser rate according to size.

This method necessitates a great deal of supervision, and is somewhat expensive, as the train-fares of these people have to be paid by the Company, the huts must be provided for their accommodation, and, very often, after a few weeks' work, they wish to return to their homes, and either run away or malinger, until they are dismissed. As far

more satisfactory way appears to be the system employed at Kamptee. Here, all the labour is let out to contractors, who are paid a fixed rate for the mineral they turn out, and who make their own arrangements with their people, the Company merely supplying the material to build the huts with. The coolies themselves appear to prefer this method, and never dream of attempting ruses with the contractors.

Bombay appears to have benefited considerably through this "boom" in manganese ore, over 70 per cent of the mineral being shipped through this port.

COAL IN BELUCHISTAN

The working of the mineral deposits of Beluchistan is in its infancy, and is being undertaken by a few pioneer firms who are Parsis and Mahomedans, but there are indications that the exploitation of coal and chrome-iron-ore is about to be takn up by Syndicates. In 1903, by simple methods, 47,740 tons of coal were taken from the Beluchistan mines, and in 1904, despite stoppages of work by severe weather in the last three months, the output was 45,894 tons. The main output is from the Khost and Sharigh mines, which are worked by the North-Western Railway, and these produced 37,275 tons in 1903 and 34,574 tons in 1904. During the past year, coal outcrops have been found in six places between Duki and Chumalang, the coal extracted being reported to be of excellent quality. Only one of these seams is at present being worked and that by a contractor, who finds a market for the coal in Loralai. Coal would probably displace wood-fuel throughout the province, if it were not for the cost, which is kept up by frequent interruptions in transport arrangements, caused by bad weather. Improved means of communication are therefore required, and Major Archer, the Officiating Commissioner, urges that the scheme for a tramway to certain mines, suggested many years ago, should be now reconsidered.

COAL IN UPPER BURMA

In a paper by Mr. T. H. Holland on recent geological explorations, furnished to the Board of Scientific Advic, some particulars are given of the coal-deposits in the Northern Shan States of Upper Burma. The Namma and Lashio fields were surveyed last year, and the geological party

discovered two new fields near Mansang and Mansle respectively. The largest thickness of any seam was 4½ feet, and the quality of the coal has apparently not been fully tested, but doubtless it is much the same as that in the neighbouring fields. Unfortunately, coal in Upper Burma is not of the kind found in Bengal and other parts of India. We are told that, in the Lashio field, it is lignite in character with a large quantity of moisture and sometimes with a considerable amount of ash, resulting in a fuel of low grade, which can only be of local value on the railways after briquetting. The lignite in the Namma field is slightly better in quality, but is still unfit in its raw state for use in locomotives. The most important seam, however, varies in thickness from 7 to 17 feet, and as it has been proved for a distance of 800 yards, the quantity available for working must be very large. Perhaps, in course of time, the manufacture of briquettes may be undertaken, and this kind of fuel can then be used on the Burma Railways. One rather wonders, with the enormous output of petroleum in the Province, that oil-fuel has not been resorted to, both for locomotives and for river-steamers. In Russia, there is a large consumption of petroleum on certain railways and on the Volga Steamers, and satisfactory results have been gained from its use.

COAL IN ASSAM

A very good coal-mine has recently been discovered near Shillong. Here is a good field for capitalists.

COAL IN EASTERN BENGAL

The only coal-field in Eastern Bengal and Assam now exploited is, says a correspondent of the *Indian Trade Journal*, the Margherita coal, is sold to tea-gardens, one mile away from the colliery, at Rs. 13-8 a ton and 200 miles away at the same rate ; this is the only coal to be had in the new Province, at present. It is far removed from Dacca, Naraingunge, Chittagong and other central parts of the Province. There is also a little coal extracted at Cheraponjee and sold in Shillong at very high-rates. This Cherapoonjee coal-field contains one million tons ; but sometime must elapse before it is opened out scientifically. The most extensive coal-field, and near to the centre of the new Province, is the Garo Hills coal-field. The Daranaggiri coal-fields extend for twenty square-miles, the average

thickness is 5 feet 6 inches, 7 feet 6 inches at Daranaggiri, and 3 feet 6 inches in the Rengchi, and the total amount of coal is assumed to be, by the Government Geological experts, 76 millions of tons. The correspondent suggests that Government should do for the Garo-field, what was done when the Umaria coal-field was opened out,—work it themselves for the first few years, and then sell it all to miners, at a fair-rate. To develop the field properly, it will be necessary to build a railway from the Dacca-Mymensingh line to a point at the mouth of the Sumeswar River. There is a great future for the Eastern Province, and if this Garo-coal should prove suitable for carriage in ocean-going steamers, it can be carried from the mouth of the Sumeswar River to Chittagong for export, at the low-rate of Rs. 3 a ton, approximately; the coal ought to be landed at the mouth of the Sumeswar River at Rs. 3-8 a ton with profit, making the rate to Chittagong Rs. 6-8 a ton. This would place Chittagong on an equal footing with Calcutta, in regard to price of coal for export.

PROSPECT OF COAL TRADE IN INDIA

The Indian coal-trade, appears to be still in a bad way. At the annual-meeting of the Indian Mining Association for 1904, the burden of song of most of the speakers was pitched in a despondent note. Though there has been some increase in the total output of 1903 upon that of 1902, prices have not come upto expectations. Like the tea-industry, over-production is generally believed to be responsible for the prevailing low prices of Indian coal.

The Hon'ble Mr. Cable in his budget-speech in the Viceroy's Council, 1904, observed,—

"The trade in coal at the present moment presents a very curious spectacle. On the one hand, collieries in Bengal are, with few exceptions, being worked on the barest margin or being closed altogether, while, on the other hand, coal from abroad is being delivered almost at our doors".

In 1905-06, the exports of coal and coke from India, exceeded all records in respect of both quantity and value. The largest quantity previously shipped had been 594,832 tons in 1904-05, and

the largest value of shipments was Rs. 59·39 lakhs in 1900-01. The record attained in 1905-06 was 837,251 tons with a value of Rs. 65·81 lakhs, which figures exceed those for 1904-05 by 40·7 per cent. in quantity, and 41·4 per cent. in value.

A GEOLOGICAL FIND IN THE CENTRAL PROVINCES

A correspondent writes :—The Central Provinces have, of late years, been brought much before the public notice in regard to their mineral-wealth. The Sleemanabad District, however, which lies rather to the north-east of Jubbulpore, has been much neglected. During the last three or four years, Mr. Dutt, of Jubbulpore, has been very active in searching for ore-deposits. The result of his researches has been the discovery of the mineral *fluosspar or fluorite*, which though common in many parts of the world, is quite a rarity in India. This has been reported on by the Geological Survey of India in their Miscellaneous Notes published early this year. The occurrence is a series of parallel metalliferous veins, striking in a north-west direction, through dolomitic limestones of Archæan Age. Whilst opening up these deposits, other minerals were discovered, such as :—*Chalcupyrite Tetrahedrite, galena, pyrite* and *barite*, with *malachite, azurite, chryscolla* and oxides of iron and small pockets manganese. Mr. A. Whyte, of Raniganj, found a rock (17·782) near the Erie Pit which the Geological Survey described as a *quartz-felurite* or *quartz porphyry.* The mineral which is causing a considerable stir in this district, is copper ore, which has been discovered in a vein, and by means of a diamond drill is being further proved. It is understood that Mr. Dutt is working in conjunction with the firm of Messrs. Burn & Co. of Calcutta. The copper-reef so far discovered, lies close to the surface, and has been proved by means of shallow trial shafts, and a heading or gallery has been driven a short way into it. The mineral brought to the surface is of very fair quality, and it is understood that an English expert is to come out and report on the value of the find.

COPPER IN INDIA

Copper was formerly smelted in considerable quantities in South India, in Rajputana and at various parts of the outer Himalyas (Kulu, Garhwal, Nepal, Sikkim and Bhutan). Indigenous Copper has, however, been

completely sup-planted of recent years, by the imported material. The average value of copper, imported during the last 3 or 4 years, has been over one million sterling per annum.

The current high prices of copper should serve to encourage continuous prospecting for the metal in India. The Geological Department have been busy during the past few years in exploring for coal and mineral deposits generally, but they have not, so far, discovered rich copper-lodes. The work of examining likely localities will doubtless continue, and among these are the hills to the west of Sini, the Railway Junction, where the Tata Iron and Steel Works are to be erected. There will be no lack of prospectors, if scientific reports regarding copper-deposits are favourable in the areas under examination.

TIN

(AN EXTRACT)

Tin has a wider distribution than is generally recognised, and its minerals are often overlooked through the difficulty in distinguishing them from other heavy minerals. It exists in nature as a compound known as *Cassiterite* or Tin-stone. Tin is plentifully found in the Malayan States. Isolated crystals of *Cassiterite* have been recently found in the Palanpur State (Bombay Presidency). Tin has also been known to be produced in Burma and the Hazaribagh District of Chota Nagpur from river-sands by native iron-smelters, in addition to the existence of ores *in situ*.

The principal deposit, which has either been wrongly described, or has received less attention than it deserves, occurs in the Palgany Estate, near the Barakar river.

The average amount of tin-ore, raised per year in Burma, for the period 1898-1903, has been 1,645 cwts. (82·5 tons) valued at £6,876. The metal is exported mainly in the form of block-tin, almost all of its going to the Straits Settlements.

The tin exported from Burma is a small quantity compared to the requirements of the country. Cornwall and Devon, in England, are famous for their tin production.

The amount of foreign unwrought block-tin imported to India during the period 1898-1903, averages 27,000 cwts., valued at £1,37,000 for one year.

As regards the prospects of tin-mining in Burma, it may be worth notice that the country in which the ore occurs lies in a belt connecting Yunnan, the south-west province of China, in

which tin-mining is said to support a large population, and the well-known tin-ore deposits of the Straits Settlements to the South, from which in 1903, 54 per cent. of the world's supply of tin was obtained.

The newly discovered mine in Palanpur (Bombay) covers a large ground. Its prospecting has been taken in hand by some Bombay merchants, and we may look forward for some very profitable results.

GADOLINITE

A VERY RARE AND VALUABLE METAL

Gadolinite (named after *Gadolin*, a Russian chemist) is a rare but valuable substance. It is a compound mainly composed of the three elements (1) *Berellium* (2) *Yttrium* (3) *Cerium.*

The Calcutta gas-jets have lately been covered with a *Yttrium* and *Cerium* netting and the lights have thereby been rendered more powerful and the flame more brilliant and whitish.

Cerium is chiefly obtained from another mineral substance known as *Monasite* (Phosphate of *Cerium*). The percentage of *Yttrium* is greater than *Cerium* in Gadolinite. Formerly, it existed only in some parts of Norway and Sweden and on the banks of the American river, Colorado. A mine of Gadolinite has been recently discovered in Bombay, which extends over a wide territory and will, in future, prove a great source of profit to those engaged in it. A ton of *Monasite* sells at Rs. 3,000. The Bombay Gadolinite will not surely fetch a lower price. Gadolinite does not require steam-engines, boilers and other elaborate expensive apparatus. It exists chiefly on the surface of the soil and the rock with which it is found in combination, is very soft and may easily be crushed down. Thus, this industry does not require a big capital or any superior mechanical qualifications for its working. The extensive use of gaslight in the civilized world will always provide a profitable market for Gadolinite.

DIAMONDS DEARER

It is no exaggeration to say that, in twenty-five years, there will be as much locked-up capital in a diamond necklace as there is in the average industrial concern today, and these stones will be sold at such a fabulous price as to be beyond the reach of any but the richest of the rich. During the past two years, the price of diamonds has jumped up 25 per cent; during the past six months, the price has risen 10 per cent.; in

another two years diamonds will be another 20 per cent. dearer. Two years ago 2-grain ($\frac{1}{2}$ carat) stones could be purchased for £15 a carat. Now they are £22 10s., while 4 carat stones have gone up from £21 a carat to £32 or £33. Several of the largest firms, with sufficient foresight and capital, have, for the last two years, been steadily buying as many diamonds as they could get, to safeguard themselves against this rise. The reason for the rise in the price of diamonds is that, the mines are becoming less productive, although producing finer stones—whiter and more brilliant. Emeralds have gone up 50 per cent and there has also been a big increase in the price of pearls and rubies.

DIAMOND MINING IN CENTRAL INDIA

The last number of the Records of the Indian Geological Survey Department contains an interesting paper on the Geology of the Native State of Panna in Central India, with special reference to the diamond mining industry of the State. The principal diamond-yielding lacalities are the following:—

In the Panna State—Shahidan, Chumba, Maraia, Bandi, Bhowanipur, Harduarpur, Srinagar, Ogra, Mankapur, Majgama, Old Panna, Chota Manakpur, Kalianpur, Ganeshpur, Radhapur, Hardua, Balepur, Itwa, Birjpur, and Udesua.

In the Chankari State—Khameria, Ranipur, Patto and Brajaria.

In the Chobpur State—Dia, Scha and Jhanda.

In the Patar Keshat State—Majgawan and Bauari.

In the Kothi State—Jhanda and Naigrwa.

The methods of working at these localities are classified as 'direct workings,' 'shallow (surface) workings,' and 'alluvial workings.' The disposal of the diamonds are regulated in the following manner. The diamonds are sold by auction at Panna at the beginning of each month. In the case of stones of less than 6 *ratis* in weight, the owner obtains three quarters of the price and the State one quarter. After the highest bid, the original owner has the option of buying the stone at that figure. Stones of 6 *ratis* and over, are the property of the State. The finder in this case gets one quarter of the value. The majority of the Panna diamonds are said to be either of a brilliant white, such as is very seldom met with in South African gems, or are of that still more beautiful blue-

white, which is quite unknown amongst South African specimens and are very seldom clouded or flamed. Their commonest defect, from which, it is said, very few are entirely free, consists in the presence of *'spots,'* which are black opaque inclusions of jagged outline. Owing to this defect, a large number of stones are unfit for the European market, though they are saleable in India. Of the 'direct' workings, those at Shahidan, near Panna, are said to be by far the most productive; the workings at Bhowanipur give, at present, the best return amongst the 'surface' or 'shallow' workings; while the 'alluvial' workings that give the best yield as regards quantity and a good average weight, are those of Itwa.

DIAMONDS IN INDIA

Mr. E. Vredenburg, Deputy Superintendent, Geological Survey, last year (1905) made an examination of the Panna diamond-bearing tract, and has prepared a long report on the mode of occurence of the gem-stones, and the present state of the industry, with suggestions for improving the methods of mining. The report will be published as a special Memoir. The report contains a general account of the geology of the Bundelkhand States. The diamond in the conglomerates, like the associated large pebbles of lighter rocks, are derived from older rocks, and the original home of the gem is still unknown, though, a precise recognition of the associated pebbles will gradually indicate the direction in which the mother-rock once occurred and possibly still exists. The most characteristic pebbles in the diamondiferous conglomcrates are the jasper-pebbles, derived from the Bijawar-formation and the vein-quartz similar to that traversing the Bundelkhand granites, the latter being especially abundant in the conglomerate lying above the Rewa sand-stone. Besides the diamonds lying still embedded in the conglomerates, others are found in the neighbouring detritus derived from the disintegration of the Vindhyan beds. The workings are developed accordingly,—some with a view to the removal of the undisturbed conglomerate, and others with the intention of recovering the diamonds included in the more recently distributed detritus.

The undisturbed conglomerate is often covered by considerable thicknesses of younger Vidhyan rocks, and is reached by workings which are often, but not always, deep. These are referred to by Mr. Vredenburg as 'direct work-

ings". In other places the overlying younger rocks have been removed by weather-agents, and the conglomerate thus exposed at the surface is available for "shallow workings." In the detritus removed from the original conglomerate and deposited river valleys, the diamonds may be reached by superficial shallow, or comparatively deep working and they may be all spoken of conveniently as "alluvial workings." Mr. Vredenburg has given an interesting series of statistical results with regard to the crystallographic characters, weight, lustre, colour and origin of the diamonds collected during the quarter in which he examined the area. The area immediately around Panna appears to be still the richest part of the field. Besides various improvements possible by more systematic organisation of the shallower workings. Mr. Vredenburg points out that the constancy of the conglomerate over large areas, and the regularity of the gently *inclinde strata*, would permit of sinking deep-shafts to the dip, with a view to mining out the diamondiferous conglomerate on a plan common to all bedded deposits. The extension of this work in the direction of the dip, would naturally depend on the results obtained in the shallower shafts with regard to the persistence of the diamonds with the conglomerate. Judging by the present cost of working and the estimated average return in diamonds, there appears to be a distinct margin of profit to be expected from systematic mining operations of depths down to 200 to 300 feet. The work should, of course, be commenced on an experimental stage, and under the management of a competent mining engineer.

FORMATION OF DIAMONDIFEROUS ROCKS

Regarding the formation of diamonds, Mr. Dinkar G. Joshi of Satara, writes—"** The theory of the meteoric origin of these diamondiferous rocks is a most suggestive theory, and is perhaps borne out by a scientific examination of the Kimberley beds in South Africa.

The public may not be aware that we have also similar rock-formations in India. In the Nizam's Dominions, for instance, (*vide* Watt's Dictionary of Economic Products of India, Vol. III, page 98), we have a series of rocks which resemble the Kimberley-Group, and which, at one time, supplied valuable diamonds, including the famous *Kohinoor*. But these bear a definite known relation to the

geological formations encasing them ; and the stones never exploded or cracked on exposure to the air,—a circumstance which somewhat militates against the meteoric-theory. The same is, also, I presume, the case with the Panna-fields, in Bundelkhand. The point is, however, one of great practical importance and will, it is to be hoped, receive further elucidation.

RED SAND

A kind of red-sand has been found in Cape Comorin. The clebrated firm of Messrs. Parry & Co., of Madras, are exporting it to London, where it is being utilised in plastering. It is being sold at Rs. 40 per ton.

GLAZED CROCKERY FOR INDIA

An Indian resident in Singapore has been studying the process of manufacturing the cheap kind of glazed-crockery which the Chinese send to India and which are largely used here. It appears that, for inferior ware, a high degree of purity in the clay is not insisted upon, and the suggestion is accordingly made that clay containing red-earth or red oxide of iron, such as is found in large quantities in several places on the West Coast of the Madras Presidency, could be utilised. While the Indian potter's wheel is primitive for the moulding of the clay, the Chinese cost only a few Rupees, and their use could easily be learned by the average potter. The colouring materials employed by the Chinese are not selected for æsthetic effect, but for their cheapness, red-oxide of iron being commonly employed. The glaze is made of paddy-husk, lime and clay, which are converted, by the addition of water, into a thick-liquid. The wares, having been dipped in this preparation, are put in a kiln, built of common raw-bricks. A kiln, capable of turning out Rs. 300 worth of crockery at a time, could be built for Rs. 400. The whole cost of a pottery-producing-establishment should not exceed Rs. 1,000.

KHARI AND *SAJJI-MATI*

Besides Sodium Chloride, other salts of soda, notably the Sulphate (*Khari*) and Carbonate (*Sajji*), accumulate in the soil of areas where the climate is dry, and both the Sulphate and the Carbonate are prominent amongst the Sodic Compounds in the brine of

the Rajputana Salt Lakes. A conspicuous instance of a salt-lake in which the Carbonate is most prominent is the crater like Lonar Lake, occuring as a roughly circular depression, in the Deccan trap-flows of Berar.

Besides the impure *Sajji-mati*, of which considerable quantities are still in use, the trade-statistics show that its imports are distinctly increasing, and that common country *Sajji* is gradually being displaced.

For information concerning the alkali-compounds used and manufactured in India, see, Agricultural Ledger, No. 5 of 1902, published by the Reporter on Economic Products, Calcutta—(Holland's Mineral Production of India).

SODA AND *SAJIMATI* (FULLERS EARTH)

A correspondent writes in the *Bengalee*:—"I possess some land in Ghazipur which produces soda and *sajimati* in abundance. I beg to invite the opinions of experts as to the best use that can be made of them with detailed process.

MICA MINES

Its uses as an Industry

Mica is a rising industry in India. It requires a big capital to start with. Rupees twenty-five thousand (Rs. 25,000) at the least is required. The percentage of profit increases with the increase in capital.

India is the largest producer of mica in the world and the mines of Hazaribagh, Gaya and Monghyr share with those of Nellore in Madras, over 99, p.c. of the Indian total, which amounted in 1904-05 to 19,575 cwts., valued at £5 per cwt.,—a total much greater than that of the two chief competitors—the United States and Canada combined. Mica-mining in Nellore continues to be the most flourishing mineral industry in Madras. Mica-mining was, untill lately, the monopoly of India, but now Canada, the United States and Brazil are producing mica. In Canada and the U. S. A., the supply falls short of the demand but still there is some talk of a prohibitive import-tariff to check the import of Indian mica into America. New York and London are the two great mica-markets in the world. In 1900, 1700 tons of mica worth £175,000 were exported to London. One-half came from Bengal and the remaining half from Madras.

Those engaged in mica-industry in this country might be interested to learn that there is a growing demand for mica in the Australian Commonwealth, especially in industries connected with electricity. Prices are high and, we should fancy that the Commonwealth would be a good customer for the Indian product, the working and output of which is steadily increasing yearly. In Chatkura in Gaya, the Government has lately granted a licence for prospecting. At the end of 1904, there were some three score of applications for mica-mining leases in Hazaribagh, under consideration of the district authorities, of which a large number had been granted.

Mica is found in hilly regions. Mica-mines in Bengal are situated in the hills surrounded by forests and having very few inhabitants.

In 1901, Bengal produced Rs. 25,50,000 worth of mica. The small Kodarma, about 300 miles from Calcutta, is now a centre of Mica-mining. This mining territory lies some miles to the south of the Nowada Station of the E. I. Railway. The E. I. Railway is constructing a branch-line to the Mica-fields. Mineralogists detect the presence of Mica-mines by chemical analysis of the soil and by examining the surface of the ground. Indian (Native Indian) prospectors detect the presence of Mica-mines by looking for particles of mica on the ground after heavy rains.

Mica-mines are found about 200 to 600 cubits below the ground. As mining goes on, water oozes out from below, but is quickly pumped out. Mica is found imbedded in rocks, which are pounded down by mortars, or, when very hard, blown up by dynamite. Red, black, white and other varieties of mica are found in the mines. The rocks are cut in the form of blocks and are sent to the Factory. These blocks are classified in seven classes :—

Special	class	blocks	measuring	over	35	Sq. in.
1st	,,	,,	,,	,,	24	,,
2nd	,,	,,	,,	,,	16	,,
3rd	,,	,,	,,	,,	10	,,
4th	,,	,,	,,	,,	6	,,
5th	,,	,,	,,	,,	4	,,
6th	,,	,,	,,	,,	2	,,

These are again divided into two classes according to quality. The mica-blocks are packed in boxes, each containing 1 Md. 10 srs. of mica and they are sent to London, *via* Calcutta.

Uses of Mica

Mica is used :—

1. In industries connected with electricity.

2. As a substitute for glass. Mica does not burst with excessive heat like glass.

3. To cover the sides of vessels, in which boiling-water is kept up in steam-engines.

4. In many other parts of steam-engines.

5. Toys of many kinds are made in India of mica.

6. As ornament in Delhi and Patna.

7. For chimneys in Europe.

8. As an ingredient of an explosive like dynamite called "Mica Powder". Experiments are being carried on to melt mica into any desired form, which, if successful, would create a revolution in the mica-industry.

Prices of Mica in London

It is sold at very high prices in London. Special Class per pound Rs. 7-8-0; 1st. Class—Rs. 5-4-0; 2nd Class—Rs. 3-12-0; 3rd Class Rs. 2-10-0; 4th Class—Rs. 1-8-0; 5th Class—8 As.; 6th. Class—6 As.

The inferior quality sells at half the above rates. The management of most of the Mica-mines is in the control of Europeans and the profit they make is immense. It is a pity that the attention of the capitalists of our country is not directed to this potent source of profit.

DECLINE OF INDIAN MICA EXPORTS

The exports of Indian Mica have been steadily decreasing in value, from 1895 to the present time, and that of Canada has been almost as steadily increasing, so that, whereas in 1895, the value of Indian Mica was nearly three times that of Canadian, in 1904. Canadian stood higher than Indian.

MICA PROSPECTING RULES AND LICENSES

The rules for the grant of prospecting licenses and mining leases for Mica in Bengal were revised in April 1902 and are printed *in extenso* with those for Madras in the Memoir on Indian Mica, published by the Geological Survey in 1902. The important changes introduced in the rules were:—

(1) The levy of a royalty in the case of prospecting licenses at the rate of 5 per cent. on the sale value of Mica;

(2) The abolition of the system of putting up leases of Mica-mines to auction, and provision for restricting operators to approved methods;

(3) The raising of the maximum period of leases to 30 years;

(4) The grant of power to lessees to relinquish their grants during the currency of their leases.

Of the prospecting licenses issued during the period 1898-1903, seven were granted in Nellore, four in Coimbatore, one

in Godavari, and one in the Tinnevelly District, Madras Presidency. In the Central Provinces, one was granted in each of the three Districts—Balaghat, Hoshangabad, and Chhindwara. In Burma, one license was issued for each of the two districts of Magwe and Mandalay, and two each for Myitkyina and the Ruby-mines District. In Assam, one license was granted in the Khasia and Jaintia Hills. In Rajputna, four licenses were granted in Ajmer-Merwara, making a total of 27 licenses, covering 3,223 square miles.

IMPORT OF CORAL

The Collector of Customs, Calcutta, informs that the quantity of coral imported in year 1905 (126,023 lbs.) is lower by 29 per cent. than in the previous year, and represents the smallest importations since 1885-86; but prices were higher. The Sicilian fisheries are reported to have failed, the banks being practically exhausted. Japan also has not been able to respond to the demand. Here exorbitant prices are asked for good qualities, but although they are higher than buyers are willing to pay, the demand is still good, especially from Nepal and Tibet. Generally, imports were interfered with by the growing demand for artificial Coral, which has become a severe competitor of the genuine article. How severe is the competition, may be judged from the fact that, the value for artificial Coral imported in the past year was only 27.8 per cent. less than the total value of the real Coral.

SYLHET-LIME AND CEMENT

A recent development of importance has occurred in quarrying the nummulitic limestones of the Khasia and Jaintia Hills, partly for use in the manufacture of Lime, popularly known as the 'Sylhet-Lime,' or for use as simple limestone, and partly for the manufacture of Cement near Calcutta. In 1898, the amount of limestone quarried in this District was estimated at 61,105 tons, but considerable fluctuations were shown in subsequent years, with a general improvement to 88,675 tons in 1903.—Holland: Mineral Production of India.

SUTNA OR KATNI LIME

For some of the quarries in Lower Vindhyan limestone near Katni, returns are available since

1901, when the quantity raised was 28,000 tons, followed by 30,091 tons in 1902, and 35,238 tons in 1903 A limestone of Upper Vindhyan age is being worked near Sutna by a Joint-Stock Company, but much of the material is carried by rail to the Barakar Iron Works, a distance of 530 miles, where it is used as flux in the blast furnaces.—*Ibid.*

MINERAL-PAINTS

Upto the present, the manufacture of Mineral-paints appears to be very small, compared to the demand and the natural resources, in minerals apparently suitable. In the Jabalpur District, Mineral-paint works are utilizing the soft *hematiles* of Jauli, and are drawing supplies of yellow ochre from the Panna State, whilst similar works near Calcutta are dependent largely on imported material.

Ochres, red, yellow and of other colours, are commonly used by natives in many parts of the country, in a crude or simply levigated-form and are known under the generic name *geru.* A common source of supply is the *Laterite* in the Peninsula and Burma, but well-defined ochres occur in deposits of various geological ages down to the Archæn *hematiles.* In Trichinoply District, yellow ochre is obtained from the *Cretaceous* rocks, and in Burma large deposits are known amongst the Tertiary beds of the Myingyan District. A black-slate near Kishengarh has been successfully tried on the Rajputana-Malwa Railway. *Barytes,* used as a substitute or adulterant for "white lead," is obtainable in quantity near Alangayam in the Salem District and in the Jabalpur District, but no attempts have been made to turn the deposits to account for pain -making.

Orpiment, the yellow Sulphide of Arsenic, is largely imported into Burma from Western China for use mainly as a pigment. During the six years, 1897-98 to 1902-03, the average annual imports across the Indian frontier amounted to 9,551 cwts., at an estimated value of £11,470, or 24 shillings per cwt. The last three years ha.e shown a decided increase in the trade, with, however, an average reduction in the price per cwt.

The mineral is used as a pigment in the manufacture of Indian ornamental lac-wares and the Burmese lacquer-work, in which the favourite greens of the Pagan-workers are produced by mixtures of indigo and *orpiment,* and the so called gold-lacquer of Prome, by powdered *orpiment* and gum. It is used also for the designs on the Afridi wax-cloths.—*Ibid.*

MINERAL-WATERS

Instructive Hints

One curious feature in connection with Indian minerals, is the neglect of our numerous hot and mineral-springs. To what extent the value of these is purely fanciful, is a matter of small concern for the time being; for whether they have the medicinal properties claimed for them or not, there is no doubt that well-advertised mineral-waters have an economic value, and numerous varieties from Europe and Japan are seattered over India, and brought to the continual notice of the travelling-public in all railway refreshment-rooms. Natives of India have for many ages recognised a value in mineral-waters and in the hot-springs which are often charged with more than usual quantities of mineral matter. Generally, it may be said that Indian hot-springs, often sulphurious, are common throughout the Tertiary areas of Sind and Baluchistan on one side and of Assam and Burma on the other, in the distribution being similar (and perhaps dependent on similar causes) to the distribution of petroleum, with its constant associates of salt and gypsum. Other springs occur along the foot-hills of the Himalayas, in the Kharakhpur Hills, etc., sufficiently well-distributed to permit of easy transport. The Provincial Gazetteers contain sufficient references to these springs to guide private enterprise, but more might be done in the way of analysis of waters, which would be as interesting from a scientific as possibly from an economic point of view. The mineral water of Sitakund in the Kharakpur Hills is the only one which has been turned to account.—*Ibid.*

SLATE

Slate-quarrying gives a means of livelihood to numbers of workers along the outer Himalayas, where the foliated rocks, though often not true clay-slates, possess an even and perfect facility, which enables them to be split for slabs and even fine roofing slates. In the Kangra District, a Joint-Stock Company has organized the work in a systematic manner, and, for the past six years, has declared dividends of 12 per cent. with the addition of considerable sums to the reserve-funds. The same Company works quarries in clay-slate amongst the Aravalli series, near Rewari, south of Delhi.

In the Kharakhpur Hills, a private Company is working a

slightly metamorphosed *phyllite*, which, though not giving the thinnest varieties of roofing slate, produces fine slabs, for which a more extended use is continually being found. Slate is also being worked in various parts of the so-called transition series of rocks on the Peninsula; but no figures are available to show the extent of the trade.—*Ibid.*

STEATITE

One of the most widely distributed minerals in India is Steatite, either in the form of a course pot-stone—so called on account of its general use in making pots, dishes, &c.—or in the more compact form suitable for carvings, and in its best form, suitable for the manufacture of gas-burners. There is a trade of undetermined value in nearly every province.

An exhaustive account of the Indian occurrences of Steatite was published by Mr. F. R. Mallet in the Records of the Geological Survey of India, Vol. XXII, part 2 (1889); and a Note by Mr. H. H. Hayden in Vol. XXIX (p. 7,) of the same publication, adds further details with regard to the deposits in Minbu District, Burma, where the annual out-turn is estimated to be worth from £300 to £500. The returns which are confessedly incomplete, give an average annual production in India of about 35,000 tons, valued at £1,900. –*Ibid.*

Supplemental

PROSPECTS OF THE INDIAN MINERAL OIL

Up to the present, all attempts to develop the oil prospects of India have been without success, except in Burma and North-East Assam. Burma holds an easy lead, and if its resources hold out, the present rate of development will soon displace foreign supplies.

Assam

The delay in the development of the promising petroleum resources of Assam, is an instance of a remarkable diffidence and want of enterprise existing in the commercial community, which could show the reckless speculation of the gold boom of 1890. As long ago as 1865, an account of the Makum area was published by Mr. H. B. Medlicott, F.R.S., in the Memoirs of the Geological Survey, and trial-borings were then recommended. This advice was followed in 1867, when a Calcutta-firm obtained permission

to prospect, and struck a promising oil-spring at a depth of 118 feet near Makum ; but nothing more was done until 1883, and only very slow development occurred in the following sixteen years. The Assam Oil Company was, however, formed in April 1899 with a nominal Capital of £310,000 most of which was quickly called up and invested in the erection of a new refinery at Digboi and in systematic drilling operations with the result that the output rose from 631,571 gallons in 1901, to 2,528,785 gallons in 1903. Besides the ordinary illuminating oil and solid paraffins, the Assam Oil Company has made a successful attempt to put petrol on the Indian market. The following table shows how the output in this area has been rising during the last six years :—

1898	...	547,965	Gallons
1899	...	623,372	"
1900	...	753,049	"
1901	...	631,571	"
1902	...	1,756,759	"
1903	...	2,528,785	"

The belt of Tertiary rocks extending from the north-eastern corner of Assam for some 180 miles South and West shows frequent signs of oil, nearly always in association with coal and sometimes associated with brine-springs and gas-jets. The series of earth-folds, in which this corner of Assam occurs, stretches southwards to Cachar, where oil-springs are also known, through the little-known Lushai Hills into Arakan, and in the same system of parallel folds occur the oil-fields of the Arakan coast on one side of the Yoma, and those of the Irawadi valley on the other.

Burma

The most productive oil-fields of Burma are those on the eastern side of the Arakan Yoma, in the Irawadi valley, forming a belt stretching from the Magwe District, in which the well-known field of Yenangyaung occurs, through Myingyan, in which Singu occurs, across the Irawadi in to Pakokku, where Yenangyat is situated. Oil is, however, known further south in Minbu, Thayetmyo and Prome, and further north in the Chinduin valley, but these areas have not so far been throughly prospected, and the great development which has recently taken place, has been the direct outcome of work in the three fields, Yenangyaung, Yenangyat. and Singu.

Besides the Upper Burma oil-fields, the islands off the Arakan coast, noted for their mud-volcanoes, have also been known, for many years, to contain oil-deposits of uncertain value. The chief operations have been carried on in the Eastern Barongo

Island near Akyab and on Ramri Island in the Kyanphyn District. During the past 6 years, the average output of the former area has been 42,926 gallons, whilst in Kyaukphyu, the output in the same period has averaged about 100,000 gallons with a distinct tendency to decline.—HOLLAND: MINERAL PRODUCTION OF INDIA,—1898-1903.

UTILISATION OF MINERAL FERTILISERS*

RESOLUTION OF BOARD OF SCIENTIFIC ADVICE

The Government of India has communicated to the Local Government, the resolution of the Board of Scientific Advice, dated 5th May 1906, for the consumption of mineral fertilisers in India. The resolution runs thus:—

The members desire to endorse the opinion that Agricultural Departments, both Imperial and Provincial, should undertake experiments to test the results of the use of principal mineral fertilisers. In particular, they recommend that special attention should be given to the trial of *Sulphate of Ammonia* in sugar-cane cultivation. This fertilizer is very largely used for sugar-cane in Java and Mauritius, both of which countries are exporting to India an increasing amount of sugar. The Sub-Committee understand that *Ammonium Sulphate* will shortly be manufactured in India, which should result in a cheap and available supply for the use in the country. Arrangements are already well advanced for the erection of by-product-recovery-ovens in coke-making. When the Tata Iron and Steel Manufacturing project is in operation, the output of *Ammonium Sulphate* will greatly increase. Arrangements are also being made for prospecting *Copper Sulphide*-deposits of Chota-Nagpur, and, if they proved as valuable as is asserted by some authorities, it is probable that a large chemical and metallurgical industry may be started, by-products of which will include *Sulphuric Acid* and *Ammonium Sulphate*. It is naturally to the interests of India that these should be utilized as far as possible in the country, rather than exported and agricultural departments should make experiments to test their utility in cultivation, particularly that of sugar-cane.

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* *Vide* Part I for similar subjects.

HUMAN FOOD FROM COAL

A Startling Discovery

It seems that science is about to undertake the task of feeding mankind artificially. Dr. Emin Fischer, the winner of the Nobel Prize in 1902, Professor of Chemistry in the University of Berlin, and the greatest exponent of the new synthetical chemistry, has succeeded in building up from the cells of coal, a *proteid*, the most important form of food, which supplies muscle and tissue to the body and is absolutely necessary to the maintenance of life.

Referring to this food, a scientific American paper says: —

"This discovery bears probably a more tremendously important relation to the conditions of every day life on earth than any other that has yet been made by modern science. It means that the food-problem of the world is solved, probably for all time. No longer will man depend for food on the accidents of vegetation and the private ownership of property. The chemist will obtain it for him directly from the natural substances that have been lying in the earth almost since its creation. The chemist will take the place of the wheat-field, the cow, the sheep and the butcher. All these agencies, and an enormous number besides, are now required to obtain man's food from the earth." The crops and the cattle occupy a vast amount of space and the food they furnish is subject to enormous fluctuations and diminutions on account of drought, disease and other accidents, causing great suffering and famine in the poorer countries. Moreover, the difficulty of gathering and transporting these forms of food is so great, that, it affords unlimited opportunity for speculators to corner and otherwise manipulate the market. Now, that the food can be built up artificially from the original cells, the raw material will be found almost anywhere and all the difficulties mentioned will be obviated. It happens that coal furnishes the necessary cells in the greatest abundance, and, therefore, becomes, in the chemist's hands, the richest of foods."

Dr. Fischer received in 1902 the Nobel Prize of $ 40,000 for the scientific discovery of the year, that had chiefly contributed to the good of humanity. This was awarded to him for solving the nature of and artificially constructing starches and sugars. And now he came to his great work on *proteids*—the flesh-making foods. A *pro-molecule* when split up, yields as the

produpeptone, and the *peptone* when further split, yields a number of *amino-acids* which are composed of nitrogen, carbon, hydrogen and oxygen. The nitrogen in this, makes the fundamental difference between *proteid* and *carbo-hydrogen*, for nitrogen is esential to the formation of tissue. There are many of the *amino-acids* and a slight difference in their arrangement produces such widely different things as fish and fowl.

He has obtained from the refuse of coal practically all the scents of the flowers, from roses to violets and all the flavors of the fruits from pine-apples to peaches. He has reconstructed sugar in various forms from the same material. All these wonders are the result of synthetical chemistry. In its early days, chemistry was analytical, that is, concerned with splitting up substances into their component elements. When analytical chemistry had progressed to a certain point, it became possible to put together elements and build them up into complex substances. That was synthetical chemistry. That is how, in the course of years of investigation, it became possible for Professor Fischer to reconstruct food from coal.

FOR (1) ALUMINIUM (2) GLASS-MAKING MATERIALS (3) CLAYS (4) KAOLIN, *VIDE* PART III.

PART III.

TRADE, COMMERCE AND INDUSTRIES

GENERAL HINTS ON TRADE AND BUSINESS

The *first* principle is economy. Even one pice must not be spent unnecessarily, but, on the other hand, when necessary, one should not mind spending rupees.

The *next* most important thing is personal supervision.

Thirdly—A thorough knowledge of the working of the particular Trade or Business.

Fourthly—Sufficient capital.

Last, but not the least, is honesty and punctuality.

All these must combine in one, if success is to be guranteed.

TRADE WITH LIMITED CAPITAL

It is generally the case that only those who have capital to invest can become traders; the poor are obliged to serve those traders for their livelihood, and, getting only small pittances, anyhow to eke out a miserable existence.

We shall here mention several articles of jungle-produce, which grow wild all over the country and of which regular shipments are made abroad from Calcutta, *e. g.*, *Dhatoora* (for Belladona) Myrabollam, Tamarind, Simul Cotton, Akund Cotton, Nux-Vomica, Dry Ginger, Turmeric, Bee's Wax, Bahera, Stick Lac. It is only necessary to collect and send them to the proper market for sale. There is no necessity of investing any big capital, as, these articles will not have to be bought in any market or manufactured at great cost. A beginning can be made by any one with nominal or no capital.

DHATOORA

Dhatoora-tree grows wild nearly all over Bengal and does not require any special care for growing or preserving it. Domestic cattle have very little liking for it, nor the people of the village any earthly reason to disturb its growth. It, therefore, grows wild and unmolested, and there is no necessity of specially preparing the ground to grow it. The seeds can be sown broad-cast

on any waste-land in the village which may be rented from the landlord at specially cheep rates and during its growth, there is no need of employing labour to take care of the trees. Dhatoora trees take about 6 or 8 months to grow and when fully grown, they may be utilised in the following way for mercantile purposes.

Belladona—is a kind of drug very largely used for several medicinal purposes and has therefore a very big sale all over the world at a very high rate. In fact, its demand all over the world is so great that any supply, however big may it be, cannot cope with it. Again, with the speedy spread of European civilisation over the parts of the world, where formerly no civilised mode of treatment existed, the demand for all sorts of European medicines is always on the increase. This most valuable drug—Belladona—is prepared out of the leaves, branches and roots of this much neglected *Dhatoora* tree.

Leaves of Dhatoora, when the tree is full grown, are plucked or cut off, and after carefully cleaning them of all the dirts and dust that naturally accumulate on them, they are dried in the *shade*. On no account are the leaves exposed to the sun, for in that case, the leaves lose much of their medicinal properties. The outward sign of finding out whether the leaves have medicinal properties left in them, is the retention of their natural green colour. If the leaves become faded grey in colour or become brittle, as the result of their drying in the sun or in a place very near its rays, the leaves are useless. It must therefore, be carefully watched that they retain the colour and a little of the natural moisture—a condition generally attained 8 or 10 days after the date of plucking. When in this state, the leaves are collected, made into bundles of maund each or some other more convenient size, and packed in the same way as Tobacco is done. These bundles or drums may then be sent to Calcutta, where they are packed in bales of 400 lbs in hydraulic presses and sent to Europe or America, as the case may be.

Leaves may be sold, landed in the foreign markets, including the cost of packing, marking, shipping and freight at the at about £20 to £22 per ton at least. Taking Rs. 15 for £1, £22 means Rs. 330 per ton (27 mds. 11 seers) or about Rs. 12 per maund. This, of course, includes the charges and the freight, but they do not exceed Rs. 2-8 per maund as shown below,—

	Per maund
Ry. Freight to bring it down to Calcutta	0 10 0
Cartage, &c., in the village ...	0 1 0

Supervision	0	2	0
Packing charges in the mofussil ...	0	3	0
Do. in Calcutta for baling ..	0	4	0
Cartage at Calcutta	0	2	0
Weighing, marking and shipping charges	0	1	0
Freight to Europe or America at £ 1 per ton	0	10	0
Bill brokerage, Commission, Insurance, &c. ..	0	4	0
Rs.	2	5	0

Thus, deducting all expenses, there is a clear net balance of Rs. 9-11 per maund left as profit to any one who may attempt the trade. This, undoubtedly, is a very good return.

Trunks and roots.—Leaves may be divided into three classes: the first class containing is all the big, perfectly green and faultless leaves and the other two classes are composed of leaves neither nearly so green, nor faultless as the first. Then come the trunks and roots, which also are sold at very high rates,—about £14 to 15 per ton, landed at the port of destination, including all costs and freight which is equivalent in our money, free of all costs, to about Rs. 6, to 6-8 per maund. Nothing, therefore, of the *Dhatoora* tree is valueless; and is it not a wonder that such a valuable tree should have been so much neglected?

In a bigha of land, if the trees are planted about 2 yards apart, 400 trees may be easily grown. These trees with but a little care, last 3-4 years, and taking each of them to yield only about a seer of leaves yearly (which is a very low average) the annual outturn of a bigha of land comes to 10 maunds of leaves which, at the rate of Rs. 9 per maund, at the lowest, will amount to Rs. 90 per bigha. The trunks and roots of a tree also weigh at least 3 seers; and therefore, in a bigha of land, at the end of every 3 years, when the trees become too weak to yield healthy leaves any more, about 30 maunds of trunks and roots may easily be collected, which, at the rate of Rs. 6 per maund at the lowest, may fetch Rs. 180. There is thus a further income of about Rs. 60 a year. In all, therefore, a bigha of land may fairly return about Rs. 150 per year—a fairly big income which no other crop is expected to yield, and which is obtainable without any appreciable investment in money or labour on the part of the grower. There is again hardly any fear about the trees dying through a drought, for the *Dhatoora* trees are very hardy, their roots fairly long enough to draw subsoil water in sufficient quantities for their nourishment.

Thus we find that the *Dhatoora* trees which nobody has ever dreamt of as being of any value at all, except for their occasional use in the Ayurvedic Medicines, may yield a very substantial income, by far greater than jute, sugar-cane, or any other crop requiring large

investment both of money and labour. Another great advantage is that it may be grown on any land, high or low, on the slopes of hills or embankments or any other waste land productive of no other crop. —Market Report.

Akund Cotton

Of the many articles of Jungle produce, *Akund* cotton has got a very good demand for export. Large quantities are shipped every year to Europe and America for purposes of making Lint-cloth and is also used largely for preparing a kind of bandage-cloth for Rheumatic or Gout patient. There may be other uses for this cotton, but that is not known here.

This cotton, unlike the Simool cotton, has good and fairly long staples and may be used for weaving other kinds of cloth also. When spun, it looks very white and is of a very silky and soft texture. On account of its long fibres, people who know all about cotton-trade predict a good future for it. At present, large quantities of it are not available and the cleaning machines are not numerous enough to cope with any sudden increased demand. At any rate, the demand is steadily on the increase every year.

At present, more than eighty per cent. of *Akund* cotton is supplied from Agra and its surrounding districts. In Bengal, this cotton is totally neglected and no systematic attempt has been made either to grow or collect it. Whatever little is brought down for the Calcutta Market, is rather poorer in quality than the Agra sort, and in consequence, the shippers do not much care for it.

At Agra and the surrounding Districts, there is a regular cultivation of this kind of cotton, smaller though it is, and the cultivators carefully look after it and collect it in proper time when it is perfectly ripe, whereas in Bengal, there is no regular cultivation and the people gather it at random from wild trees and mostly pick it from the ground, when blown down from trees.

The *Akund* is one of the several kinds of tree-cotton found in India. The trees are not very substantial and grow to a height of about 5 to 7 feet, very weak and tender and move *to* and *fro* with the wind. The trees begin to bloosom in November or December. The flowers are about $\frac{1}{2}$ an inch in diameter and are very pretty to look at. A few weeks after flowering, small pods appear which take about 3 weeks to mature; and then, all on a sudden, the pods burst and the cotton, which originally looks like a round ball formed of hairy fibres, is blown with the wind and scattered on the ground. It is so very light that even a slight

breeze—even a breath will make it blow away from the tree. It is generally collected when in pods, for when the pods burst, the cotton is blown away to a very great height by the wind and then it is very difficult or rather impossible to collect it.

After collecting the pods, the cultivators generally cover them with fine nets so that the cotton may not be blown away by wind, when the pods burst. They then collect the cotton carefully without opening the net, till every thing is bagged.

This cotton, like *Simool*, is mixed up with seed, which have to be thoroughly picked out before shipping. For this purpose, there are a number of cleaning machines established in Calcutta. Nearly 30 to 40 per cent. of the gross weight goes for the seed.

The cost of the cultivation is small, whereas the price at which it may be sold, as will be found from the Report of the Calcutta Market, is high—there is thus a good margin for profit for one to take up its cultivation on a systematic scale.

In a bigha of land planted about a yard apart, there may be about 700 to 725 trees. Taking each tree to yield annually about 4 chittacks of clean cotton, there may be about $2\frac{1}{2}$ maunds of clean cotton available in each bigha in a year. Taking the value of clean cotton at the lowest at Rs. 12 per maund, one bigha of land planted with *Akund* cotton may yield about Rs. 30 a year, whereas the cost of production is very insignificant, as will be found from an approximate cost of growing it, given below. Besides the cotton, the leaves of *Akund* tree are also valuable and may fetch a very good price in Europe, where it is used for medicinal purposes.

It is not necessary to prepare the ground specially or with any great care, neither is any specially fertile land necessary for its cultivation. No care is necessary to preserve the trees from the depradation of the village cattle, as they have no liking for them. Therefore, except the rent and the cost of planting, there is no special expense involved.

	Rs.	As.	P.
Rent of 1 bigha of waste-land ...	0	4	0
Cost of planting,—which may be done easily by 4 men in a day, wages of whom at ans 4 a day ...	1	0	0
Cost of collection,— 1 man may do it if he works every morning for one or two hours for a month which the cultivator himself can do, but taking his wages at 1 anna a day	1	14	0
Other charges	1	0	0
	Rs. 4	2	0

So we find the cost of production including cleaning, may not be more than Rs. 4 to Rs. 5 per bigha or for $2\frac{1}{2}$ maunds of clean cotton, which may easily fetch Rs. 30 at the lowest. Sometimes

it sells as high as Rs. 20 per maund, in which case the profit is much larger but on no account is there any loss from its cultivation. Besides, there cannot be any harm to the plants either from drought or excessive rain. When once planted, the cultivator is sure of a good return, if he only takes the ordinary care necessary for growing anything.

Besides the profit from the sale of cotton, there is a very handsome profit from the sale of the leaves. The stalks yield soft and very light fibres and by themselves would form a paying industry. In the Malaya Islands various articles are being made out of this fibre, as from cotton.—Market Report.

Simool Cotton or Kapok

Very few villagers are aware of the real value of *Simool* cotton. They know it to be useful only for making pillows and beds with for themselves; and it is distributed gratis to their neighbours if they want it for the same purpose. They have scarcely any idea that there are millions outside zone of the *Simool*-cotton-growing-lands, who may also want the stuff for the very same purpose as themselves and who are quite prepared to pay—and do actually pay—very good price for it.

If any one cares to go to the country-side during April and May, he will find fields and the tops of trees white with a silky, breezy article shinning brightly against the rays of the hot sun. Looking from distance, to the European who has seen the falling of snow in his own country, it appears as if everything has been covered over with snow. On coming nearer, he will get himself a thin coating of the stuff on his body, which it will be difficult, for him to rid himself of.

This is *Simool* cotton, allowed to spread itself out all over the village, without any attempt on the part of the villagers either to check it in time, which they can easily do, or any attempt made to collect the spreading-cotton.

Simool cotton tree grows wild in large numbers all over Bengal, Behar, Orissa, Assam and nearly in every part of Southern India. They blossom in February; and, towards the end of March, pods bearing cotton appear. These pods ripen in the beginning of April. When over-ripe, these pods burst and the cotton is blown away by the high-winds, which generally blow in Bengal during part of the year.

Simool cotton, or rather the pods bearing cotton, should be brought down when they are ripe, just before the time they generally burst. The pods are then collected in a place and spread out in the sun in a clean place, to avoid the cotton

being mixed up with dirts, sticks and straws. These pods have then to be properly covered up with a fine net to prevent the cotton from escaping as the pods burst. The cotton comes out of the pods in a few days and sticks to the net very thickly, when it is collected in bags.

In its natural state, *Simool* cotton contains very large quantities of seeds, so much so, that 20 or 25 seers in a maund or about 50 to 62 per cent. is lost in seed. Before it is made marketable, most of the seeds is taken out by beating the cotton with sticks, when the seeds, being heavier, fall to the ground and cotton remains floating at the top. The seeds are also collected separately and bagged, as they contain, in small portion, a kind of oil, which is used in soap-making and is also a very excellent cattle-food. Barks and pods, except as fuel, are of little value. The *Simool* cotton has very little market in the villages, first because the villagers do not use it for mattresses to sleep on, and those that use it for making pillows, generally do so once in every 10 or 15 years. Hence, there is very little use for this article in the villages. In the towns also the use was not so very extensive as to have made it necessary for the villagers to busy themselves in collecting this cotton. Small consumption for local purposes as well as very limited sale in the towns, and at quite unremunerative rates, were not so very tempting to the villagers to induce them leave aside their usual works to collect this cotton. The same old state of things still continues, though the circumstances have greatly altered since.

About 20 years ago, very large quantities of wool used to be exported from here, as is even now the case, to Europe, which was no doubt in most part, used to be spun into woollen cloths, but not very small portion of it also used to be stuffed into beds to make them soft and springy. The people of Europe used the wool for the very same purpose as we do *Simool* cotton here—which was not only very costly but did not yield the same amount of comfort as our *Simool* cotton. They occassionally used to import a very superior kind of *Simool* cotton from Java, but in respect of cost, it was much higher than wool and was not obtainable in very large quantities.

The people of Europe did not know, till then, that a kind of cotton very like that of Java is obtainable in India. The writer of this article is the first person who, finding that a great sale may be made of *Simool* cotton of Bengal in Europe, and thereby another source of bringing in money to India might be easily opened out,

suggested to a friendly European merchant if he could sell this cotton in Europe. As usual, in the first instance, he could not be persuaded to take up the article which he represented, was more dirty in comparison with either perfectly cleaned wool or extra fine Java cotton. He further boasted that even the European sweepers would not look at the stuff, if it is offered to them free of charge. In justice to him let it be said that the sample of cotton that was shown to him was not at all clean and it contained large quantities of seeds, besides sand and dirt. There were no cotton-cleaning mills then in existence here and it used to be cleaned with sticks which could never clean the cotton as perfectly of seeds and dirt as is being done now. But nothing undaunted, I myself cleaned a small parcel of about one pound of cotton by hand and rather forced him to send the same to Europe. About 2 months after, the friendly European merchant received a letter from his agent in Europe asking him to ship a few sample bales for trial not forgetting to write in the letter that the chance of success of the article was not very bright but at the same time informing him that there might be some chance of introducing the cotton amongst the poorer classes of people, who *might be induced to take it. My* friend greatly hesitated, but on my assuring him that if there was any loss I would fully bear it, he shipped only 10 bales of *Simool* cotton, cleaned under my supervision. The shipment of the 10 bales was the pioneer of an altogether new industry in India and is now the means of livelihood of thousands of people. Still it has a greater future before it, as it is not yet known in every village that *Simool* cotton can be sold in large quantities and at remunerative rates.

From the market reports, it will be found that good cleaned cotton may fetch such a high price as Rs. 17 per maund, which is sure to leave a very good margin to the villagers, if they collect the stuff systematically—MARKET REPORT.

'SIMOOL' WOOD

THE MOST SUITABLE MATERIAL FOR TEA-BOXES

The Conservator has continued to pay attention to the question of reserving areas for the growth of *Simool* wood, which is the most suitable local material for tea-boxes. The Lieutenant-Governor desires to press the great importance of this question, and he trusts that prompt measures will be taken to maintain [illegible]

areas, and to open out others suitable for its growth.

The 'Statesman' makes the following Interesting Comment :—

The "swadeshi" tea-box has come to stay. The Assam Forest Administration Report for last year records the sale to Indian tea-planters of over half a million tea-boxes made of timber grown in Assam. This is a hundred thousand more than in the previous twelve months. It looks, at last, as if the reproach that timber-growing India has to send to Norway for wood in which to pack its commodities was being removed.

TAMARIND

There is scarcely a native of India, old or young, who does not know Tamarind. This is an article which is in daily use amongst the people of India, specially Bengal, who make delicious *chutnies* out of it, which always form nice side-dishes to their simple breakfast and dinner. In short, a Bengalee, and specially one from the District of Burdwan, considers it as one of the most useful articles of food and can scarcely do without it. Besides using it as one of the articles of food, the people of this country, do not know any other use of this article.

It may easily lead a foreigner to believe that such an article which is used universally by the rich and the poor, must have a very high commercial value in this country ; such is not the fact. The Tamarind-trees are so common in the villages of Bengal that, every man, even very poor, has at least one Tamarind tree which he may call his own. Each Tamarind-tree, when full grown, yields a very large quantity of Tamarind (sometimes more than 25 to 30 maunds a year) and as only a very small quantity is sufficient to serve the needs for domestic use of a family, the people generally allow the surplus stock to run to waste. There is no value for Tamarind in the villages and one can take down as much as he likes from a neighbour's tree, without any protest from the owner.

The tree, botanically known as *Tamarindus Indica*, grows all over the tropical part of the world, to a height of 30 to 40 feet and nearly covers an area of one-fourth of an acre. They bear a kind of fruits (pods) generally 3 to 8 inches in length, covered with hard outside shells and generally with 2 to 6 seeds inside, covered with an acid and juicy pulp.

This pulp forms the substance of the Tamarind-fruit, which, when analysed chemically, yields—sugar and acid tartaric largely, and, in small proportion, citric and other acids and potash.

The Tamarind-tree generally flowers in May or June and the pods or fruits begin to form from the middle of December to the first part of January, and ripens generally from the month of February. When unripe, the substance inside remains very hard and becomes soft and juicy, when ripe. The people, until lately, knew no other use of Tamarind than making *chutnies* of it. They did not know that it could be exported to Europe in large quantities for purposes quite different.

The largest quantity is used in making a kind of acid, known as *Tartaric Acid*, which has a large consumption all over the world. It is also used in making fast-colour and a liquid pulvy substance which is mostly used by the people all over Europe, during summer as a most delicious cooling drink.

It is sold in Calcutta at rates, varying from Re. 1-12 to Rs. 2-8 per maund ; but on occasions, though very rarely, it has been seen to go up as high as Rs. 4-8 per maund. The price varies more or less according as the Tamarind contains the pulp and as there is demand for export. The season for export begins generally from September when the colour becomes black and continues all round the year. The average value of this stuff is, however, Rs. 2 to 2-8 per maund.

It is nearly valueless in almost all the villages of Bengal, where one may get a full crop of a big tree, amounting not less than 20 maunds or so, for a rupee or two at the highest. The cost of bringing down the pods and the cost or taking out the seeds also donot come to a very much. In all, it never costs any one, who cares to bring down the pods from the trees and does everything under his own superintendence, more than twelve annas to Re. 1 per maund and therefore, the nett cost of bringing it down to Calcutta cannot possibly exceed Re. 1 to 1-1 per maund at the highest. In consequence, the rates of Rs. 2 to Rs. 2-8 per maund at Calcutta are always remunerative and can always leave a fair margin to the dealer.

An approximate cost of one maund of Tamarind is given below for the perusal of the people, who want to take up this trade. As it does not require a very large capital, anyone, even with a very small capital, may take the trade up, with a return as much as his capital. If he can only manage to secure 500 hundred maunds a year.

he may command a profit of at least Rs. 500 a year or Rs. 40, Rs. 45 a month with only a small capital of Rs. 100 or 200. When such means are in existence, it is a matter of great wonder that people with tolerable education and small means, should run after service, which now a days can never bring to them more than Rs. 18 or Rs. 20 per month. In adopting trade in the place of service, they not only live an independent life themselves, but also help to open up the untapped resources of the country and thereby benefit their country also.

Cost of 1 maund of Tamarind.

	Rs.	A.	P.
If 1 tree full of Tamarind weighing 20 maunds cost Rs. 2 per piece .	0	0	9
Cost of bringing down the pods	0	0	6
And taking out the seeds (which generally form about ½ the weight)	0	2	0
Cost of bringing it to Calcutta from any village in Bengal, including Railway freight or both Railway freight and boat hire, at the highest	0	8	0
Other costs, such as brokerage, cart and cooly, &c. .	0	4	0
	0	15	3

Thus an original dealer may bring one maund of Tamarind to Calcutta, at about Re. 1 per maund. From the above, it will be seen that the largest amount of outlay that one has to make, is in taking out the seeds and Ry. freight. The other costs are all subsequent costs, which are payable from the sale-proceeds. If the Tamarind is salable at the lowest at Rs. 2 per maund, he makes about Re. 1 per maund of nett profit, if he does everything himself.

For the facility of those who have no capital, the Calcutta *Aratdars* or agents generally advance 75 per cent. on the goods stored in their godowns. Therefore, if anyone only brings the stuff by instalments of 100 maunds at a time and gets advance on the stuff brought down at Calcutta at 75 per cent., he need not invest more than Rs. 100 for his capital and that also for the first time. For the 100 maunds that he brings down to Calcutta only costs him about Rs. 100 at the highest, but he gets on the consignment, which is worth at Calcutta Rs. 200, Rs. 150 at 75 per cent. on the value. Thus, he gets Rs. 150 or Rs. 50 more than what he invested on it. With this money he can bring again 150 maunds next time, and so on; gradually he can manage to bring down a large quantity during the season and can manage to make profit many times more than the capital he originally invested.

Thus anyone who can put together a small capital Rs. 100 or Rs. 200 in the beginning of the Tamarind season, he can make in the end Rs. 500 or 600 and, if he is wise enough to keep the capital for investment in the next

season, he can put together a very nice capital for investment in any other business.

We believe the people in the villages, who, at the present hard time, cannot get land for cultivation and cannot employ themselves in any other way, may take to this trade which may be carried on with a very small capital and with a very good profit—Market Report.

THE MAHUA TREE AND ITS PRODUCT

A Profitable Industry

This very useful tree is found in Behar. Its Sanskrit name is मधुक (*madhuka*) or मधुद्रुम (*madhu-druma*). When the tree attains full growth, it looks like the mango tree. The roots of the tree penetrate in straight lines into the earth, but do not go very deep down. The trunk of the tree is very large and its bark is tough, with a reddish tint. If the bark be pierced with a knife, a gum-like juice comes out of it. The flowers of the tree are very beautiful to look at, and at first sight, are often taken to be the fruits of the tree. The leaves drop off from the tree in March, and within a month, some 40 to 50 leaves come out of every twig and the tree begins to flower. The flowers, as soon as, they are full-grown, drop down on the ground, and are collected together and dried in the sun. These dried flowers are in taste and odour, much like grapes. The flowers grow in bunches from every twig, on stems about 8 inches long and project towards the ground and can easily drop down in consequence. All the flowers fall down by April, when the fruits begin to ripen. The fruits are of two varieties. One variety looks like small betel nuts. the other variety is of larger size. The fruits are rather tender and burst on falling to the ground and the seeds within come out.

Utility of the Flowers

The flowers are carefully collected in Behar, where the people eat them both raw and cooked. They are very nutritious as food. A kind of very cheap liquor is distilled from the petals of the flowers. It is indeed so cheap that one pice worth of it (about 1 seer) would be sufficient make one drunk: 6 gallons of liquor (proof-spirit) can be obtained from 1 cwt. of the flowers. One full-grown tree yields 7 or 8 maunds of flowers. For the above reason, the petals form an article of commerce and are transported from Behar to many other parts of the country. The liquid obtained from the flowers when boiled down, sometimes yield

molasses. This molasses is not inferior to that obtained from the date-palm, but it sells at a lower price on account of its being deficient in crystals.

Oil from the Seeds

The oil obtained from the seeds looks like *ghee*, and, on account of its cheapness, is often used as an adulterant of *ghee*. This oil too is exported from Behar to many places. The seeds can be pressed in an ordinary oil-pressing machine. The husks which remain after the oil has been pressed out, form an article of diet. The Mahua-oil is used in the preparation of soaps and candles, in the same way as cocoanut-oil. It yields no smoke or offensive smell when burnt. This oil, when mixed with otto, is used as a hair-oil in the North-Western Provinces and goes by the name of '*Phuloa*.' The Mahua oil sells in the London market at £35 per ton. This oil is found efficacious in many kinds of skin-diseases. The gum of the tree, too, is used in pharmacy.

General Notes

The value of the Mahua tree as timber is also not insignificant. Barren and rocky lands, which will grow nothing else, grows the Mahua. It does not require much watering. The seeds should be planted in the middle of the rainy season. The seedlings should be produced in one place and then transplanted. The trees should be planted 20 to 25 cubits apart. The trees begin to yield flowers and fruits in 7 years. At the end of 10 years, the produce is about half the maximum-probable-yield. The full yield is given after 20 years and lasts about 100 years.

One full-grown flourishing Mahua tree yields about 4 mds. of flower, which will ordinarily sell for Rs. 2 in the market. The seeds that one such tree would yield would be 2 mds. yielding 16 srs. of oil, priced at Rs. 2. The trees of the Chapra-side of the country are more vigorous and productive than elsewhere. Lots of barren and otherwise unproductive lands, of which a good deal lie waste in every village, might be thus made remunerative. Planting trees 25 cubits apart, one bigha will hold 8 trees. If one tree yields at least eight annas, the income per bigha will be Rs. 4. Even if half of this goes to the landlord, he is more benefited than he can expect to be from comparatively better lands. At the same time, the *raiyat* gets a good income too. There is no trouble, except for 1 or 2 years, till the plant have taken to the soil, is entailed. Of course, for, the first 8 or 10 years or so, there will be no income.

His Highness the Gaekwar of Baroda, with a view to ex-

tend on the Mahua trade, sent specimens of the Mahua grown in his territories to England for examination by experts, who gave out that the Mahua was very suitable as food for cattle, as well as distillation of liquor. Domestic animals love to eat the dried flowers of the Mahua, which are invigorating food to them and further prevents attacks of the cattle-pest *'weevil'*.

Fourteen years ago, Mr. Lockhard, an Indian Civilian, wrote in an English Magazine:—'Indians would benefit greatly, if Mahua flowers met with a demand in England. The vast forests of Mahua trees, which now yield little profit to their owners, would soon become a source of wealth and the collection of the corollas would give work to thousands of poor people' The Mahua industry requires but a modest capital for its working. Those who would like to be engaged in business with a small capital, may turn their attention to this industry. Vast expanses of semi-hilly and otherwise barren, soil—which are however very suitable for the Mahua —are lying waste in the country, which can thus be given a highly profitable turn too.

Water Supply
AS PROFITABLE TRADE

It is perhaps mostly attributable to our bad luck that, with the increasing poverty of the country, we are also gradually losing all the several natural advantages, which contributed towards making of India one of the richest countries in the world. Our land is losing its fertility, rivers are drying up, tanks and big lakes are every day filling up, diamond and gold-fields have been exhausted and in short, every thing which helped India to grow rich are gradually one by one disappearing from the land. We find therefore, to our alarm, that we have to fight with both God and man to bring back our vanishing wealth.

Of all the above disadvantages, scarcity of water is the foremost and our principal attempt ought to be in the direction of finding means, to have a copious supply of water both for drinking and cultivating purposes. Every year during the hot season, if the early rains fail, a universal cry is heard from almost all the villages in the land, for drinking-water, and thousands die for want of it—not to speak of the loss through leaving the fields uncultivated.

Our Government have, in several places, where it is possible,

made canals and other irrigation works, but to expect them to take up the vast and immense works, of supplying water throughout the length and breadth of the land is next to impossibility. The work, therefore, must be taken in hand by the people of the country themselves, and as there is an ample chance of getting a very good return for any capital that may be invested in the enterprise, we fail to understand why it was not been commenced before.

The first principle of trade is to supply what is wanted, and as water is always in demand everywhere, a trade in water after the Government irrigation principles, is sure to be a success. Where there is river close by, say within 3 or 4 miles, water can he pumped out of it and brought down to the place by pipe, viaduct or by the simple process of cutting channels on the ground. In this case what is principally required, is a good powerful pump and the subsequent expenses for the means of bringing down the water to the required spot.

In the absence of river the only way to get water is to tap the natural water-bed, which always is found at a certain depth, varying accordingly as the land is high or low. As soon as this natural water-bed is tapped, we get a perpetual supply of water, which can be stored in suitable reservoirs for use in times of need.

We can get a very good return for any investment that we may make in this connection. There is no doubt that, want of sufficient supply of water during the months of June to October is felt in almost every province of India. It has, therefore, become a necessity—an urgent and great necessity—to start the greatly beneficial and at the same time most profitable trade of supplying water to all the Districts where the want of the regular and proper water-supply is felt. The people will hail such arrangements for water-supply, with great delight and will gladly contribute sufficient sums to keep up the business to the great profit of the promoters.

We give below the approximate costs of erecting the necessary machinery to supply water to a tract of land, say 6,000 bighas in area, (about 1,800 acres) river being within 3 miles of the field.

	Rs.
Boiler, 10 Horse-power	2,000
Engine, 8 H. P.	2,500
Bucket-water-lifter, capable of raising 350 gallons per minute or pump ...	1,500
Erecting a projecting structure into the river to place the pump or bucket contrivance or to cut a channel to bring the river-water to a convenient place near the pump ...	2,000
Necessary viaduct, aquaduct or making passage of water to the field ...	5,000
Rs.	13,000

Thus the first outlay will be Rs. 13,000 and the yearly cost for keeping the work going will be as under :—

	Rs.
Cost of coal for 40 days in a year at the rate of Rs. 5 per day .	200
Establishment—1 fireman at Rs 12 per month, 1 Tindal at Rs. 20 per month, 2 servants for the machinery at Rs. 8 per month, Rs. 16, 12 servants to keep the water channels in good order at Rs 8 per month, Rs. 96, 2 clerks at Rs. 15 a month, 30, or in all per month Rs. 174 or in a year	2,088
Interest on the capital outlay (Rs. 13,000) @ 12 per cent. per annum	1,560
Wear and tear of the machinery @ 10 per cent.	1,300
	Rs. 5,148

Thus we find that all the expenses for carrying on the work including interest on the capital outlay and wear and tear of the machine, is about Rs. 5,200 a year. If a charge of Re. 1-4 per bigha is levied which the cultivators will most gladly pay, it will bring Rs. 7,600 a year, leaving a clear profit of Rs. 2,300 per year which is equivalent to about 16 per cent. per annum on the investment. Over and above this, if any water is supplied during the winter crop season, which is also a certainty, at even half the above rate, an additional income of Rs. 3,750 may be made. Thus in all, about Rs. 6,050 a year can be made easily which means about 46 per cent. on the total outlay.

Thus, in these hard days, when 6 per cent. is considered to be a very handsome return and when large amounts are every year sunk in business, which does not even guarantee bare 4 per cent., it sounds like a fairy tale that such handsome income may be derived with such a small outlay of capital which even any small Zemindar can easily invest—MARKET REPORT.

IRRIGATION IN AMERICA

GIGANTIC PROJECTS

According to *Engineering,* the United States Government has in hand gigantic projects for the reclamation of arid lands. Works approved by Mr. Secretary Hitchcock will, when completed, fertilise 1,303,600 acres, at a cost of 37,000,000 dols. Since the works were undertaken, 54 miles of distributing canals as well as 186 miles of ditches and 147 bridges have been constructed, over 9,350,000 cubic yards of earth have been excavated, and $3\frac{1}{2}$ miles of tunnel have been driven. The Secretary of the Interior has placed the works in charge of the Director of the United States Geological Survey, who has been allowed an expert consulting engineer to advise in all technical

matters. Mr. Secretary Hitchcock states that construction work has proceeded rapidly and satisfactorily, and that particular attention has been given to those localities where the largest areas of public lands were available for reclamation, or where the extreme aridity of the climate and the character of the soil gave assurance of ultimate success. In the semi-arid parts of the country, where irrigation is still in an experimental state, and where farmers and land-owners are not yet convinced of its benefits, greater caution and slower progress have been necessary, in order to avoid risking public funds where the results would be of questionable value. In Navada. irrigation works, designed to reclaim 120,000 acres of land, have been brought into operation, and other large works are almost ready for use.

A POSSIBLE INDIAN INDUSTRY

Both in Norway and in Switzerland, Companies are being formed for the manufacture of nitrogen from the atmosphere, calculations showing that with electric power generated from waterfalls, nitrates can be put on the market 30 per cent. below the prices now ruling in Europe. The scientific process involved is not a trade-secret and it is apparently open to anyone to apply it. In the two countries mentioned, electric power, is cheap, as dynamos can be put up in almost unlimited numbers along the rivers and streams, which have rapid fall from their sources in the hills. If the experiments now being made are successful, an entirely new industry will spring up, and their progress should be closely watched in India. In Kashmir particularly, electric power can be generated at a small outlay, and a big scheme is now being carried out in connection with the new railway. Hereafter, perhaps, the manufacture of nitrates may come within the range of operations in the Jhelum Valley.

IRRIGATION BY WELL-PUMPING

Important Note

In a recently published Bulletin No. 54, Department of Agriculture, Madras with the title "Note on Irrigation by Pumping from a Well at Melrosapuram", Mr. Chatterton gives the details of the amount of water raised from a well near Chingleput (Madras) by means of a centrifugal pump driven by an oil-engine. The

subject is of much economic interest, because it is certain that if mechanical power can be applied to wells in India, the advantage over present methods will be very great. This account refers to the operations during 1903 to 1905 and shows the quantity of water raised per hour, the rate at which water percolates into the well, the cost per hour while pumping and the area irrigated. All persons interested in raising water from wells, should study the figures given in this Bulletin.

UTILISING WATER-POWER FOR ELECTRICITY

(a) Mr. Tata's Scheme

The Late Mr. J. N. Tata is credited, among his other great schemes, with originating the idea of utilising the water-power of the Western Ghauts to generate electricity for use in the Bombay Mills. According to the Indian Textile Mercury, the late Mr. Tata's sons have continued the investigations which he initiated, with the result that a Company was formed in England last summer, called the Bombay Hydro-Electric Syndicate, Limited, for the purpose of completing and veryfying the investigations made, and for bringing the project into effect.

(b) In Sweden

Utilizing Rivers.—According to a German publication, Sweden is planting to use for electricity every ounce of water now going to waste over her falls and in her rivers. Engineers are in the hills making surveys, and capital is getting ready for the call that is sure to come just as soon as the surveys are completed. The same may be said of Norway, where the waters have shorter distances to run, but are often of tremendous volume. In Sweden the power will be put to work in all manner of mills; in Norway in the mines—iron and copper.

(c) Proposed Hughli River Electric Scheme

A Gigantic Undertaking

In connexion with the application that has been made to the Government of Bengal by Messrs. Killick, Nixon & Co., and John Fleming & Co. of Bombay, for license to supply Electric Energy in the Hughli River District of Bengal, we have ascertained the following interesting particulars :—

The primary object of the promoters is to provide at low rates a supply of electrical energy for power users—that is, for driving machinery, etc.—on the banks of the Hughli River in the same manner as is now being done by Electrical Power Companies in

almost every industrial district in Great Britain. In Lancashire some large mills have recently been erected without a single chimney on the premises, the whole amount of power being supplied by these Companies, *e. g.*, Yorkshire Electric Power Supply, Lancashire Electric Power Supply, South Wales Electric Power Supply, County of Durham Electric Power Supply, the Lothians Electric Power Supply, etc., etc. The mills on the Hughli River use at present the equivalent of many thousands of horse power, and there are many other Works and Factories represent the further large power consumption. It is estimated that in all there is at least some 120,000 horse power being used at present in the area covered by the proposed license. A great many of these steam plants are now old and it is among these and the new mills and works to be erected that the Licensees look for their first consumers. The promoters by producing on a large scale, will, they believe, be able to supply energy at rates which will attract every class of power user, and it may be noted that the maximum rates they have scheduled are the same as those scheduled in the Lancashire Electric Power Company's Act. The Lancashire area, like the present Hughli area, includes many textile mills and already several thousand horse power is being supplied from the Company's mains for driving mill machinery.

Although they do not seek authority to distribute a general supply of electricity for lighting, etc., the Licensees ask authority to supply any one who takes power from them with electric light also when called upon to do so ; and it will be obvious that such authority is really essential. For example, a factory driven by electrical power from the Company's Mains, would have to be supplied with light as it probably would have no longer any steam power to generate its own electric light. The Licensees have therefore adopted in their draft license the English Clause relating to this. Beyond this they do not, in this license, seek authority to distribute energy for lighting purposes. But should any local authority or Company already have, or afterwards obtain a license to give a general supply for lighting, etc., in any local districts within the present Licensees' area, the present Licensees ask authority to supply any such "authorised distributors" with energy in bulk which would be distributed by the local Licensees (referred to as the "authorised distributors") in the same manner as if they had a generating station of their own. In small districts

it is generally found to be much cheaper to take such a supply "in bulk" from a large Generating Station, rather than erect a separate small Generating Station, with the corresponding result of a cheaper supply to the public. Hence the present Licensees, still following the Power Companies' practice at home, ask for authority to supply in bulk when called upon, but there is no obligation on the part of authorised distributor to take such a supply. The matter is one of agreement.

Lastly, the present Licensees seek the usual authority to supply any energy which they may be asked to provide for any tramway, railway or dock company for electric traction, which they could do at a very low rate, but they seek no powers in this License to build or equip any lines for electric traction. The energy will be generated by steam power, and the supply will at first be given from one Generating Station. But the full scheme provides for two Generating Stations which would be connected with each other, so as to facilitate both transmission and working and make a total failure of supply practically impossible. Transmission lines will be run on each bank of the river so as to reach practically every power user and wherever practicable they will be linked up so as to provide alternative routes for the current, thus giving additional security for continuity of supply. The Licensees have already fixed the approximate positions for their Generating Stations, and are at present making further enquiries regarding the land there. If necessary, they will apply to Government later on under the Lands Acquisition Act. In the whole of this project the Licensees are being guided by the experience obtained at home, and they only ask for the ordinary powers as given to the Electric Power Companies at home.

The area which will be covered by the proposed undertaking will stretch from Hughli to Budge-Budge, its boundaries being coterminus with the railways, but it excludes the Municipal and City areas of Calcutta. There will probably be two large generating stations at a wide distance apart, but connected with each other, so that in case of accident to the one the Mills would still be supplied by the other.

The Fruit Trade and Industry

Of all the neglected sources of wealth in India, perhaps there is none which requires comparatively

speaking, so little skill and capital to develop it as the trade in fruits. There are parts of India where some of the best fruits on earth grow wild and with a little skill and culture they could be brought to grow in perfection. But here again helplessness and apathy and very largely also ignorance which is the result of restrictions on foreign travel, are responsible for the almost utter neglect of an almost boundless source of national wealth.

Home-staying Indians would be surprised to learn that in England and all over the Continent tinned peaches and spears and other fruits sell at prices which would earn 200 per cent. or larger profits after paying for freight and all other expenses. Tinned peaches are prized as a delicacy in England. Pine-apples which grow wild in some parts of India fetch good prices in England, and Singapore has set up a profitable trade in pines with England. Fresh mangoes sell for two to four shillings in Covent Garden market; and even bottled mangoes fetch very handsome prices in England. Guava cheese and guava jelly though known only to retired Anglo-Indians would if properly advertised, become a paying business with large profits. *Lemon peel* which is generally thrown away as a useless article in India, is a commercial product of considerable value. It only wants a little treatment with sugar to make it yield good profits. *Bael* fruit grows wild in the most luxuriant abundance in many parts of India. It would be by no means difficult to set up a paying business in candied *bael.* India imports large quantities of Lemon Squash and lime juice which could all be made locally both for home consumption and for export. Preserved ginger and chowchow and other Chinese fruits are as well-known in England as in India. And there is no reason why India should not have share as one of the suppliers of the English and Indian markets. The Persians have a way of drying figs on strings which may be introduced into India. Egyptian figs and dates form a considerable item in the imports of fruit into England. And here too India might without difficulty obtain a share in the supply.

Side by side with the fruit trade, a trade in preserved and pickled vegetables might also be profitably set up. Cold countries are dependent on tinned and preserved food for their supplies in winter. And tinned tomatoes, and preserved peas, pickled onions, and cabbages and cauli-flowers might be shipped in large quantities to England. Mango and other *chutnies* are also prized as great delicacies in England.

None of the articles indicated here as likely investments for a small capital require extraordinary skill to work up. A stewpan would in most cases be the only apparatus required; and a little skill in cooking and tinning air-tight would supply the rest. But young men in India are too genteel for honest manual labour, and prefer the poverty of the dis (?) "honourable professions" to competence, and affluence won by the sweat of their brow.—Lucknow, "Advocate."

Many species of sweet and delicious fruits grow in India. The mangoes, apples, pine-apples, oranges, and lichis of India appeal even to the European taste. The export of Indian fruits to foreign countries may well prove a very remunerative industry in the hands of an enterprising man. Fresh fruits may easily be exported to foreign countries. The fresh grapes of Australia, the pine-apples of Singapore and the water-berries (paniphal) of China are always found in the Calcutta Municipal Market. If fresh fruits from other countries may come into our Markets, surely we may send our fruits to other countries as well. Mr. Jamsetjee Tata, the Bombay millionaire intended to carry on the fruit export trade on a big scale. His intentions were however frustrated by his untimely death. Some think that the export of Indian fruits would make fruits very costly in India. But this is an error. Grapes are exported into India from Kabul, still grapes are very cheap in Kabul. We should bear in mind that supply always increases in proportion to the demand.

THE BANANA "BOOM"

There has been something like a "boom" of late in the banana as a food product. Banana flour, the use of which has been vigorously recommended by vegetarian enthusiasts, has now been followed by "banana coffee." This latest imitation of coffee is made of dried Mexican and South American bananas, the process of preparation being similar to that of the coffee bean. In flavour it has little resemblance to coffee, and although its use is being promoted in the United States by a stock company, no trade effect whatever need be anticipated.

THE BANANA FLOUR

We suggested "says the "Sind Gazette," that the banana flour industry might well be taken up by the Indians to whom it would prove of great value, both as an article for export and for home

use in times of scarcity. While India sleeps, however, other nations act, and we now learn that it is intended to start two establishments on the Gulf Coast of Mexico for the purpose of converting the banana into flour and shipping the product to the United States. It is believed that the new industry will prove very profitable.

Process of Manufacture

Plantain, before it is ripe but when fully mature, is peeled off and cut into slices, thoroughly washed, and then allowed to dry in the sun. When perfectly dried it is pounded in pestle and mortar and there is beautiful flour which can be made into *roti* just in the same way as with wheat-flour only. It is more tasteful, more nutritious too, than the latter. Banana-flour is much in use in America, and there is no reason why it should not be as popular in India.

Its Importance as food and mode of use

Referring to the West Indies, the "Colonizer" in its issue of January, 1906, states that remarkable strides are being made by systematic attention to agriculture, in the culture of tropical products, and the development of new ones: and that this advance is due largely to the initiative and splendid work done by the Imperial Department of Agriculture in those islands, and by the West India Committee in England. The writer of the article goes on to mention one important industry which is entirely of today—Banaine'—a product of Jamaica.

"Bananine" is a flour-product derived from the banana. The natives of Central Africa manufacture a crude flour from this fruit; and speaking of this,—late Sir H. M. Stanley said, that "If only its virtues were publicly known, it would be largely consumed in Europe, especially by infants, persons of delicate digestion, dyspeptics, and those suffering from temporary derangement of the stomach."

The flour now placed upon the market under the name 'Bananine,' is made in British factories from the British Colonial product, and is far superior in quality to the native-made product, and possesses a higher value as food than even beef, containing, as it does, as high a percentage of proteids, whilst its caloric or energy-value is almost four-times as great.

"It is from this product,"—says the Colonizer—"that is derived now well-known "Bananine"-bread—the result of practical and scientific experiments carried over a considerable period—possessing all the qualities of a perfect food, combined with pleasant appear-

ance and flavour. The nutritive property of "Bananine"-bread is that it is very easily assimilated and is certainly appreciated by those suffering from dyspepsia and other forms of digestive disorders. It appears as palatable and digestible when freshly baked, as when several days old, nor does it become dry even after keeping. It is certainly not a luxury, but an everyday article of food, as it is sold at a price within the reach of all, and has a pleasant flavour similar to that of the best wholemeal bread."

Now, this is a subject to which the Director of Agriculture, Bengal, should turn his attention. A special officer should be deputed to collect all the available information on the subject, and the result should be published in a monograph. The Banana, or plantain, is so largely grown in Bengal, that there are prospects of an important industry being established. Banana-flour, it may be stated, is made from the unripe fruit of the plantain, of which there are several species and varieties cultivated all over Bengal.—INDIAN PLANTING AND GARDENING.

PLANTAIN AS AN ARTICLE OF COMMERCE

Banana is exported on an extensive scale from the Jamaica and Canaries Islands, and Costa-Rica to England. The weekly imports of bunches from different parts of the world can be counted by lacs, at the present day, while they were only a few thousands formerly. The demand is ever-growing, but the price fetched shows no tendency to decline.

India is the home of most delicious varieties of plantain which are sure to be made much of in England, if only they could be regularly supplied.

Now-a-days, fruit-carrying steamers are being provided with refrigerating-machines, which keep the air cool and delay fermentation of the fruits.

Messrs. Davidson & Co., the Engineering firm of Calcutta, have got a contrivance for evenly distributing breeze, called the "Sirocco Fan". Recently a few steamers have been specially fitted up with Refrigerating Machines and these "Sirocco Fans" for the transport of banana from the West Indies to England.

There seems to be a great field for Indian fruits—a most tempting variety that they are—in the London market. All that is needed is a little enterprise and some

capital, both of which are not wanting in the country.

Its Sources and Nature

The world gets its supply of bananas chiefly from three sources:—

I. From the Canary Islands. These are the smallest, and by some considered the sweetest and best. They come packed in crates, first being wrapped in cotton wool and afterwards packed with straw. The packing not only shields them from bruises, but helps to ripen them.

II. Then come the Jamaica bananas—larger and finer in appearance.

III. And then, the Costa Rican, from Port Limon, the largest of all—the largest bunches and the largest fruit, but not equal in flavour to the others.

The two last-named come without any packing. They are reared up on their stems in the vessel's hold in group of a couple of hundred bunches, with a slight partition, and another couple of hundred, and so on, with another tier on the top of them, and with provision for circulating a current of cold air through them in the summer months, to keep them from ripening too fast.

There is no Banana Tree

They are all gathered green, but should be full-grown when cut. They are never allowed to ripen in the field even when intended for home use, because they cannot much be handled when ripe, owing to the great weight of the bunches; and, moreover, the rats, bats, and birds would make sad havoc of them if left to ripen.

The banana plant is not, properly speaking, a tree at all. It has no woody fibre. It is a large, green, fleshy plant, with big leaves six or eight feet long, and sometimes two feet broad.

It grows to a height of ten to fourteen feet, or even more, according to the variety of plant and the soil and climate.

Each tree produces one bunch of fruit only, which is really the terminal bud of the plant just like an ear of wheat or barley. It has no branches; and when the fruit is ready, in twelve or fifteen months from the date of planting, the tree is cut down and done with.

An All-The-Year-Round Fruit

But while it is growing up and muturing its fruit, it is at the same time sending up from its roots other young plants or suckers—perhaps eight or nine in number.

Each of these will produce its own bunch in turn, some of them in a couple of months after the parent plant; and there will thus be a regular succession of fruit. Many of these suckers have to be

dug up and planted elsewhere, or they would be too thick on the ground.

And there is this peculiarity about the banana, that you can plant it at any season, and the fruit ripens all the year round. When once a banana-field has been planted out, all that is necessary to be done is to keep it clear of weeds, and keep thinning out the multiplying suckers.

The bananas are planted usually about 14 feet apart, but they soon fill up the intervening space; only, it is well to keep the constantly spreading suckers as much as possible in lines, so as to allow of ventilation and free passage in and out among them.

Sometimes coffee, cocoa, kola, oranges, or even pine-apples are planted in the interspaces between banana plants. In such cases the thinning-out process must be carried out rigorously.

Continued Cultivation for sixty years

The old plants, having borne their fruit, are cut up in chunks and left to decay and form manure. And, until recently, this was the only manure ever applied, for the soil is naturally very rich. I have personally known a field under a crop of bananas for thirty years, and have known that, for more than thirty years before that, it was a banana field, and that it never received any dressing of manure. But, in this case it had frequent slight renewal of surface soil, by the washings from some broken-land above, in the rainy seasons.

It will be gathered from these remarks that, the cultivation of the banana is a very easy matter. And that a correct impression is almost all the old sugar estates of Jamaica have been converted into banana plantations.

Many a fresh woodland has been brought into cultivation for the purpose, and large areas that thirty years ago were almost sandy wastes, in the summer months, by means of irrigation works, have been converted into magnificent plantations bearing fruit all the year round.

The Origin and Development of the Trade

I have seen the development of the banana-trade from its commencement. It was in the seventies that a certain Captain Baker, captain of a small coasting schooner, trading between Philadelphia and Jamaica, began to take over a few bunches for his friends. They liked them, wanted more; the taste spread and the demand increased, till, by-and-by, he had to carry bananas alone, taking flour, rice, and salt-fish back in return. Then he got a few friends around him and put on a

small steamer, then another, and yet another, and he began to take them to other ports—Boston and New York—and a company was formed called the 'Boston Fruit Company'. Then they began to purchase and lease large estates, and thus they went on until they had thousands and thousands of acres under cultivation.

Meanwhile other enterprising individuals started the business, and the negro-settlers and big property-owners, whose sugar-estates were going to ruin through the bounty-system, embarked in it, and others went to Central America, where land could be had for the asking, and began the cultivation there, until now, large fleets of steamers are engaged throughout the year in carrying bananas to meet the insatiable demand in America.

Still, little had been done to create a demand for the fruit in England. I remember, in 1881, buying four small bananas in Bradford for a shilling; but the fruit began to win its way into favour, the Canary Islands supplying almost the entire demand.

Supply of 20,000 Bunches a Fortnight to England

In the closing years of the last century, however, an effort was made to open up the trade with England. The Government offered a subsidy for ten years to any shipping company that would build suitable steamers for the trade and inaugurate a direct-line to run fortnightly and complete the voyage in thirteen days.

No company seemed very eager to comply with the conditions, for it meant sacrificing all chance of trade with the other islands on the way; but, at length, Elder, Dempster and Co., of which firm Mr. Alfred Jones, now Sir Alfred, was the leading-spirit and almost the embodiment, took the matter up and entered into contract with two Governments—Jamaica and the English Government—with what result, we know. The subsidy is £40,000 per annum, paid in equal proportions by the two Governments.

The company has to purchase out 20,000 bunches for each fortnightly steamer and to carry for private persons besides. It was undoubtedly a risk, but it has been successful. They do a considerable passenger and tourist traffic, and have taken over some large hotels for the accommodation of the increasing number of tourists. Besides fulfilling their contract as to the purchase of 20,000 bunches a fortnight, they have put on an intermediate steamer, and also, in conjunction with Elder and Fyffe, have entered into the Central American trade, bringing immense cargoes to Bristol and Manchester, and

placing the wonderful and most nutritious fruit, now within reach of the very poorest in the land.

CHINESE BREAD-FRUIT

It has been said by persons living in China that, all things considered, the pomelo or Chinese bread-fruit, is the finest fruit in the Far East. It combines the good points of the orange, with the good points of the grape-fruit. It is more easily handled than the orange, and in general description, it may be known as a cross between the orange and the grape-fruit, but it is probable that, if not the original citrus fruit, it is older than either the orange or grape-fruit. Apparently, it has been cultivated in China for at least two thousand years. It requires ordinarily only three years to grow the tree, from seed to bearing period, although, of course, the first year's crop will be very small, and commercially it will pay to hold back the bearing period for at least a year. The United States Consul at Hangchow says that its bearing period, with ordinary Chinese care, probably ranges from twenty to twenty-five years. The tree apparently grows in any kind of ground,—good soil of course producing more and better fruit than poor soil,—but the habits of the tree require no particular soil or soil conditions. The best pomeloes are grown in the lower portions of Fukien Province, and the upper portion of Kwantung Province. The best pomeloes of the world are said to come from a little valley near Chang Chew, a large Chinese city in the interior from Amoy, which has not yet been opened to foreign trade the village in this valley named Po Nan, being the centre of the trade in five pomeloes. The pomeloes grown there are of exceptionally fine flavour and size, and of splendid and showy appearance; they fetch high prices. So famous are the pomeloes grown there, that each year a special tribute of Po Nan pomeloes are sent to the Emperor at Peking. The summers in this valley are rather hot and damp, while in the winter, there are a good many frosts. The temperature will often go below 28 deg., Fahrenheit, and has been known to go as low as 25 deg. The pomelo is grown far in the interior of China, having been reported as common by travellers in even the drier portions of Szchuan Province. The Chinese say that a good sized tree will ordinarily produce from six hundred to seven hundred pomeloes, and, when it is considered that many pomeloes will run as large as seven or eight inches in diameter and even larger,

it will be appreciated that such a tree is bearing a considerable load. The fruit is more oval than round. The structure and covering also are practically like those of the grape-fruit, except that the skin and pitch-padding may be somewhat thicker on the average, and the small globules of juice and fibre or "meat" are more perfectly separated. Each section of the fruit contains a large number of seeds, but the seeds are close together on the inner edge of the section of the fruit, and are easily separated from the edible portion without breaking into the juice cells. The Chinese pick their pomeloes, as they do all their fruit, too green to get the best results, and often the quality of the fruit is poor, simply because it has not been allowed to properly ripen. This premature gathering of fruit probably also interferes with the maintenance of the highest equality of their seedling trees. Many of the producers practice grafting from trees of unusual merit, but the general rule is to grow trees from the seeds. Early picking also prevents the fruit from keeping as long as it otherwise would, but, in spite of green picking, the fruit will keep for months. The Chinese have no particular means of caring for their crop. The pomeloes are huddled in bags and receive but little care. Their keeping qualities naturally could be greatly increased by more careful handling. As it is, they are shipped in bags all over China and Japan and to the East Indies, and, in spite of rough usage, and more or less bruising, they keep indefinitely, apparently lasting until the demand for them has exhausted the supply.—JOURNAL OF THE SOCIETY OF ARTS.

THE FAMOUS SYLHET ORANGE*

[By Mr. B. C. Basu, M.R.A.C., Assistant, Director of Land Records of Agriculture, Assam]

The chief centre of orange cultivation in the Khasi Hills is a narrow strip of country along the foot of the hills bordering on the Sylhet District. Orange trees are common enough in other parts of the District, and are found at Shillong at the elevation of 5,000 feet. At high elevations, the tree does not thrive so well as in the hot steamy climate of the lower hills; it takes a longer time to come into bearing, and the fruit is of inferior quality. The total extent of the country in the Khasi Hills, in which oranges can be profitably grown, may cover an area of about one hundred square miles, certainly

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* For other articles on orange *vide* p.p. 100—105 *ante*.

not more. A large proportion of this area is uncultivable. It is upon this small area that the greater part of Bengal and Assam depends for its supply of the orange fruit. The fact gives to its Khasia inhabitants a virtual monopoly of orange cultivation for the Bengal market. Although grown in the Khasi Hills, the Khasia orange is known to the outside world as the Sylhet orange, just as the Khasia-lime is known in Bengal as the Sylhet-lime. The misnomer owes its origin to the fact that the external trade in the Khasia orange is in the hands of Sylhet-traders, who have their head-quarters at Chhatak, an important trade-mart, through which a great part of the produce of the Khasi Hills is exported to Bengal.

The orange country in the Khasi Hills is rich in agricultural produce. Besides the orange, several valuable products, such as the betel-nut, betel-leaf and the bay-leaf (*Tezpat*) are largely grown, and are important sources of income to the people. Black-pepper is also grown to a limited extent, and within recent years, the people have taken to growing coffee and arrowroot, though the cultivation of these has not yet passed the experimental stage. One wonders why the country is so fertile. The hill-sides are covered with boulders and pebbles. and shew very little soil on the surface. But the boulders and pebbles serve to hold up what soil there is; indeed if it were not for these broken rocks, very little of the soil would be left on the hill-sides, the country being exposed to a rain-fall, not far removed in intensity from that of Cherrapunji itself.

The orange is said to do best on limestone-soil. The fruit grown at Tyrna, where the soil rests on limestone, is reported to be the best grown in the District. The bulk of the crop is, however, grown on soils derived from siliceous rocks containing very little lime. Dr. Bonavia in his book on the oranges, limes and lemons of India, quotes the analysis of a sample of soil from a Khasi orange garden, which gave only ·19 per cent. of lime.

The Khasias know only one variety of orange. There is much difference in respect of quality between the fruit of individual trees, but this is not perpetuated, the invariable custom being to propagate trees from seed, a method which cannot be counted upon for reproducing the character of the individual. The fruits of some trees have thick rind; in others, the skin is thinner, and the pulp more succulent. The latter are of course, the better of the two, but they do not bear handling and transport so well, and con-

sequently, seldom find their way to Calcutta and other distant markets.

Orange trees are invariably raised from seed in the Khasi Hills. The Khasia orange grower has not yet learnt the art of grafting. Propagation by means of cuttings is not unknown, but it is rarely practised. Some care is exercised in the matter of selecting the seed. The seed-fruits are taken from trees selected for their good quality. They are plucked when fully ripe. After being pressed out of the pulp, the seeds are tested by immersion in water; those which sink are taken and those which float are thrown away as unsound. The selected seeds are thoroughly washed and dried in the sun for two or three days. The seed must be sown a short time after it has been gathered. December and January are the usual months for sowing the seed. A temporary platform is prepared with bamboo about four feet from the ground, and on it is placed a layer of finely powdered soil, four to six inches thick.

The seed is dibbled in thinly, and kept covered with plantain leaves during the heat of the day. The soil is moistened with water every evening till the seeds germinate, a matter of a fortnight to three weeks at the longest. The seedlings remain on the platform till the following May or June, when they are transferred to a nursery. The nursery is prepared in a corner of a plantation, a shady spot being selected for the purpose. The seedlings are planted out about nine inches apart. The plants receive no attention in the nursery except an occasional weeding. Here they remain for two or three years, sometimes longer, until the time comes for removing them to their permanent quarters. In the Khasi Hills, and in Assam generally, seedling oranges are seldom found to deteriorate in quality. They generally come true to seed, though no doubt, individual peculiarities are lost. Cases of deterioration due, I believe, to reversion are, however, not unknown.

A Khasia orange garden is seldom composed exclusively of orange-trees. They are always mixed more or less with other trees, *e. g.*, betel-nut, jack and bay-leaf trees.

The usual procedure which the Khasias follow in preparing a plantation is as follows:—Early in the cold weather the forest is cut down, only a few of the largest trees being left standing. These are shorn of all spreading branches so as to minimize the shade. The cut wood is allowed to dry for a few weeks and then burnt. The burning kills everything at the time, except the trees that are

left standing. But in March, as soon as some rain has fallen, grass and other deep-rooted weeds shoot up, and are dug out. Nothing more is required to prepare the ground for receiving the plants. The land receives no cultivation whatever; in fact, the rocky nature of the ground makes any kind of cultivation impossible, and there is danger, if the soil, is loosened, of being washed away by the torrential rainfall to which the hill-sides are exposed. The usual plan is first to plant out the clearing with plantain trees. These are planted in March, and begin to bear in fifteen to eighteen months after planting. The plantain clumps are allowed to remain on the ground for three years, at the end of which they cease to be productive and are dug out.

In the meantime, orange and useful trees are planted at intervals among the plantain trees. Before the time for removing the latter arrives, the other trees will establish themselves and cease to be in need of shade. The only treatment that the ground receives after it has been planted out is occasional weeding. Ordinarily, there are two cleanings during the year, one taking place in May after the spring rains which bring on a thick growth of weeds, and the other in October at the close of the rainy season.

The aspect of the land is a matter of some moment to an orange garden. A garden with a northern aspect is shaded from the sun for a great part of the day. On such land, the fruits ripen late, remain longer on the trees, and are not so sweet as those of a garden facing south which receives the full sunshine. Late ripening is rather an advantage in point of the price obtained for the fruits. As a matter of fact, the aspect of the land is seldom considered in making an orange garden. The area of land in which oranges can be planted is limited, and the cultivators have to put up with whatever land is available, so long as the soil is not unsuitable. Places, where the soil is excessively sandy are, of course, shunned.

Orange seedlings are ordinarily transplanted when two or three years old. The time for transplanting is May and June. Holes are dug at suitable intervals with a crowbar, or a thick pointed stick, and the plants are placed in them in a slanting position. No manure is used at the time of transplanting as any other stage of growth.

No fixed distance is observed in planting the trees, the ground being so uneven and full of rocks that planting at regular intervals is out of the question. Generally speaking, orange trees are planted

about 10 feet apart, but are often planted closer.

By the end of the rains, a number of leading shoots will have grown from the base of the plant. These are more vigorous and grow faster than the old stem which remains more or less stunted, and often dies down altogether. At the end of two or three years, the parent stem is pruned off, and one or two of the most promising shoots are preserved, the rest being cut off. The tree throws out a number of main branches a short distance above the ground. These ascend at an acute angle to the axis of the tree, and as they grow up almost vertically, they give to the tree a compact pyramidal shape, not unlike that of an English pear tree. The tree receives no further pruning till it comes into bearing. At the time of plucking the fruits, all dead and unproductive wood is removed, and the twigs, where they appear too thick, are thinned out to admit light into the heart of the tree. Mosses and parasitic-growths are also removed at the same time.

Orange trees begin to bear in eight to ten years from the time of sowing the seed. In unfavourable localities, twelve years, or even a longer time, may elapse before the tree yields its first fruits. The life of an orange tree is very uncertain, owing mainly to the ravages of the borer insect, which destroys a large number of plants annually, and necessitates vacancies being filled up constantly.

Among the insect-pests to which the orange tree is liable, the borer is the most destructive. This insect has not yet been identified, but it is believed to be the grub of a beetle. When a borer is at work, a little sawdust-like powder is found at the root of the tree, some of it sticking to the mouth of the hole, through which the grub entered. At this stage the insect could be easily destroyed by pushing a wire up the bore till the grub is reached.

Monkeys, squirrels and parrots are great pests of the orange fruit. The villagers combine to drive out the monkeys when they appear, and they are often shot. Squirrels and birds are combated with pellet bows, and various devices for scaring them. Crows too, destroy a lot of fruits, but, be it said to their credit that, they never touch a fruit so long as its skin is intact and not until it has been eaten into by a parrot or some other animal. Heavy rain in April when the trees are in blossom, is very injurious. Much damage is also caused at times by hail-storms destroying the blossoms and young fruits.

The orange season commences in November, and closes in March. The export-trade in the Khasia

orange is in the hands of the Bengali traders, who are mostly men of the Sylhet District. During the season, these men come up with their boats to the various weekly markets lying at the foot of the hills and buy up the oranges for cash. The practice of selling crops in advance, unhappily so common among the Bengali ryots of the adjacent plains, is unknown among the Khasias. The usual wholesale price of oranges varies from Rs. 10 to 20 per "hundred", which is equivalent to about 2,300 fruits. Last year's short-crop sent prices up as high as Rs. 45 per "hundred". The fruits intended for export to Bengal are taken down to Chhatak, where the bulk is bought up by wholesale merchants, who ship them to Calcutta and Eastern Bengal.

Khasia oranges can be preserved in good condition for many months by placing them on a bamboo trellis suspended from the roof of the house. The fruits must be sound, fully ripe and very carefully plucked, so as not to be bruised or injured in any way.

They are placed thinly on the trellis, no two fruits being allowed to touch each other. From time to time, the fruits are examined and those which appear unsound are thrown away. Treated in this manner, the fruits remain good for many months, almost till the next orange season comes round. The skin looks dry, but the pulp remains juicy and sweet; in fact, it gains in sweetness by the keeping. The practice of preserving oranges in this way, though simple, is by no means general among the Khasia orange-growers, and very few preserved oranges are offered for sale.

GRAPE-GROWING IN MYSORE

Grape-growing and raisin-making—the raisin is simply a dried-grape—has never been attempted in India with any great seriousness. In India, labour is perhaps ten times cheaper than in Spain or Italy, and if a good article can be produced on the spot, the duty and freight will be saved, to say nothing of the labour employed. A gentleman is now in Bangalore, who has had very great experience of the grape and raisin industries, who has read papers on the subject and been the subject of leading articles in leading papers in other parts of the world, and who has also travelled throughout India and visited Aurungabad, Dowlatabad, Poona, Nassik and other places known as grape-growing centres on a small scale. His confident opinion, after careful study of the seasons, is that the

climate of Bangalore is infinitely more favourable for grape-growing than any of the other places mentioned above, and to prove this fact, he has already had some 7,000 or 8,000 grape-vines of twenty different varieties, planted in a nursery in Bangalore and on the Nilgiris. These vines have been inspected by many people, including officials of the State of Mysore Mr. V. P. Madhava Rao, C.I.E., the Dewan, who is ever ready to encourage enterprise and energy, or hopeful schemes of any kind, has promised his earnest and utmost support to the undertaking. Mr. Madhava Rao has been so favourably impressed with the projected industry, that he has practically offered the expert a free-hand in the selection of land for grape-growing, and the locality has already been fixed upon. The thing must not be looked upon at all in the light of an experiment: given land with suitable soil, and water at a suitable depth, success is believed to be a certainty. Well backed up, the scheme should develop into a flourishing industry.

A correspondent writes to a Madras paper:—

The result of the experiments with grape farming at Bangalore will be watched with interest, but if there is as much in the industry as is believed, it is surprising that it has not been developed before this. Far-seeing planters are constantly putting down a few fruit trees on their estates, and I have known of a good many attempts being made to grow grapes; but never, I must admit, with any great success. Of course, that does not mean that vines will not do in Bangalore, for the climate there is very different from that of most tea and coffee estates. In Spain, at any rate, they make them pay remarkably well. Mr. Consul Haggard, in a recent Report on the trade of Malaga, refers to the export-trade in grapes for the British and American market. On a hectare of land, equal to about $2\frac{1}{2}$ acres, he says, 300 vines are planted out in rows at a distance from each other of from 19 to 20 feet. The total charges, including £17 4s. 4*d.* for wages, £58 10s. for oak barrels, £17 6s. 8*d.* for cutting, cleaning, packing, and so on, £6 1s. 4*d.* for carriage to port and shipment of the barrels, and the Government-tax on land, £10, amount to £125 12s., and the net value of the produce to £316 3s. 4*d.*; which leaves a net profit of £190 11s. 4*d.* upon the $2\frac{1}{4}$ acres.

VALUE OF FRUIT-DIET

Medical experts are of opinion that there is hardly any disease which is not beneficially affected by fruit-diet. In Malaria, grapes; in nervous debility, nuts; in cancer, oranges; in diseases of the lungs, water-plants; in impurity of blood, tomatoes are believed to be particularly efficacious. The Brazilian nuts act as a tonic to many. Apples, on account of its richness in phosphorus, strengthen brain-power and the nerves. Pine-apple increases digestive power and relieves throat complaints. Oranges act beneficially on the liver, while lettuce and lime-juice cure jaundice.

FRUIT-TRADE WITH FOREIGN COUNTRIES

Important Practical Hints

In the fruit industry (particularly, orange-industry of the West Indies) a stage of development has been attained, when it ic no longer sufficient to consider the quality of fruit alone. In the markets of both America and England, definite trade customs have arisen, which it is necessary to take into consideration before competition in their markets is attempted. Thus, it has become not only advisable, but essential to pack fruit in standard boxes 12½″ by 12½″ by 27″ (outside-measure) with a single median partition; each fruit should be wrapped carefully in white tissue-paper, after close examination of the individual fruits to discard any, in the least degree blemished. The fruit should, by the same examination, be carefully graded, and each grade should then be packed in layers and the number and grade marked outside each case. Too much care cannot be devoted to producing uniformity.

Such are the controlling factors as set forward by Mr. H. Hesheth Bell, C.M.G., Administrator of Dominica, in a paper on the cultivation of orange in Dominica, recently printed by the Imperial Department of Agriculture for the West Indies.

INDIAN POTATOES FOR LONDON*

A Lucrative Business

It is known to only a few that, India can grow 'new-potatoes' and land them in Covent Garden Market, London, in the months of February and March, to be sold at from *2d.* to *6d.* a lb. and re-tailed again in the West End

* *Vide* also p.p. 63—64, *ante*.

shops as a delicacy at 1s. a lb. The experiment was carried out a few years ago at Dalsing Sarai for a couple of years, several tons being shipped from Calcutta to London with success, but the enterprise was abandoned not from any failure in the packing, shipping or sale in London, but entirely from the fact that the lands at Dalsing Sarai were unsuited to the growth of potatoes which were overcome by disease and gave an unprofitable return per acre. In many parts of India, the soil is well adapted to the growth of potatoes, and where this is the case, disease can be easily checked, and a trial of the experiment is strongly recommended. The potato selected should be an early kind, such as the Jersey potato or Myatt's Ashleaf. Very satisfactory results were also obtained from the Naini Tal 'Magnum Bonum,' but, this being a late variety, it could not reach London before March, when the price began to sink. Planting should be done as early as possible in October, so that the potatoes may be lifted in January and delivered in London in February and March, before the supplies from Jersey and the Canary Islands begin to flow in. The seed should be of the best sort and should be procured from England or better from Australia, where potato-disease is less prevalent. The land should, of course, be heavily manured, oil-cake being excellent for this purpose. The potatoes on being lifted should be very carefully handled, dried for a few hours in the sun, and each potato wiped with a piece of chamois-leather. They are then sorted into two grades, packed in neat boxes 15″ by 15″ by 6″ to hold 28 lbs. and lined with paper. These boxes were shipped from Calcutta by a City Liner and delivered in London in 26 days. The potatoes arrived in perfect condition, and were sold for *2d.* a lb. wholesale. The average cost of sending the potatoes to England was £6 per ton or two-thirds of a penny per lb. Should any further information be required, it can be obtained on application to the Director, Agricultural Research Institute, Pusa, Bengal.—(B. C.)

SUGAR-CANE AND MANURES*

IMPORTANT EXPERT-OPINION

The following is culled from an article on "Manuring sugar-cane" contributed to the Agricultural Journal of India (Pusa) by Mr. J. W. Leather, the Agricultural Chemist to the Government of India :—

"The value of the sugar-cane crop depends on three factors,

* Articles on Sugar, *vide* p.p. 78—88, *ante*.

namely,—(*i*) the weight of cane, (*ii*) the proportion of juice expressible by a mill, and (*iii*) the quality of the juice. The quality of the resulting *gur* will depend very largely on the third of these factors. An ideal crop of cane is one that fulfils the three conditions—great weight of cane; high yields of juice, about 70 parts or more of juice per 100 of cane; and juice containing a high proportion (16 per cent. or more) of cane-sugar, but very little (·5 per cent. or less) of glucose. It is, however, well known that the juice of cane may suffer from several causes. Thus, for instance, if the harvested crop be not mature, the juice will contain a high proportion of glucose; if the crop becomes "lodged" (broken-down) through stormy weather, the effects on the juice are similar. Excessive manure again, has the effect of raising the percentage glucose.

The agriculturist naturally desires to have some simple hints to guide him as to the quantity of manure he should use per acre. It needs hardly to be explained that since, manures as well as the soil vary considerably in composition, it is impossible to say precisely, what weight of one is equivalent to another. Every farmer knows that one lot of farm-yard manure, or of poudrette, will be appreciably better than another, and this is the case with other materials. It pays indeed to employ a chemist to determine the quality of manures, for economies can thereby be effected, which are otherwise impossible. If, then, weights of manure are here suggested, their limitation must be recognised, and the fact that they depend on the materials possessing an average composition must be carefully borne in mind.

Subject to this reservation, the following may be recommended—

		Per Acre
Farm-yard manure	...	20 to 30 tons
Poudrette in alluvium	...	15 to 20 ,,
,, in coarser soils	...	20 to 30 ,,
Fish-manure	...	1 to 1½ ,,
Safflower cake	...	1 to 2 ,,
Castor ,,	..	2 to 4 ,,
Karanj ,,	...	3 to 5 ,,
Rape ,,	..	2 to 3 ,,

Fish Culture & Trade

FISH-TRADE IN BENGAL

Practical Hints

Fishes are getting scarce every day in Bengal. All the small rivers and water-courses are gradually silting up and the big tanks in Bengal villages, which used to supply the people with good drinking water and fishes, are by and by filling up, too. Thus there is a wide-spread scarcity, all over Bengal, of drinking-water and of

regular fish-supply. The people living in big cities are supplied anyhow with fishes imported from fish centres such as Goalundo, Sara, &c., in Eastern Bengal and from Mokameh, and other places situated on the Ganges in the Upper Provinces. Though large quantities of all sorts of fish are being daily imported into Calcutta by the different railways that have their terminii at Calcutta, so enormous is the demands for fish for consumption by its own inhabitants and for distribution amongst villages lying around it, that the supply, though enormous, is quite insufficient and can, without any fear of over-supply, be multiplied by many times, still.

There is, therefore, ample room for enterprising men to take up this trade with prospect of great profit.

But how to get the supply? The principal centres of fish-trade in Eastern Bengal are all situated on the banks of the river Padma. For some reasons or other, this river has for the past decade been losing its strength of current and the water-channel has greatly decreased. In consequence, is not capable of supplying as much fish as it used to do, some ten years ago. The fish-supply from these centres has therefore been slowly decreasing. The fish centres on the Ganges in Behar are also lacking in their yield. The Sunderban rivers and the sea are therefore the only sources left, from which fish-supply of Calcutta must be met.

The Sunderban rivers are big and good many in number, and, being close to the sea, are generally well-supplied with the different kinds of fish, much in demand. But the difficulty lies in the way of bringing the fish up to Calcutta, in as much as, the Railway terminii at Matlah or Canning Town are far away from the principal rivers. It takes great deal of time to bring down the fish from the rivers to the Railway terminus and by the time it reaches Calcutta, it is quite unfit for human consumption. If the rivers of the Sunderbans are to be utilised, arrangements for quicker transport must therefore be made first. This can be managed by running a couple of fast steamers for this trade, capable of completing the journey to and fro in as short a time as possible. These steamers must have the necessary machineries to make ice on board in sufficient quantities, so that the fish may be kept covered with ice in air-tight cases during transit.

This business, which is sure to return a very good profit, requires a capital of about one lakh of rupees to start with, for the following purposes:—

2 Fast steamers, capable of running 20 miles an hour (distance from Calcutta to the remotest part of Sunder-

ban being not more than 100 miles by circuitous way, the journey being completed in five hours) with the capacity of about 50 tons, @ Rs. 30,000 each — 60,000

2 Ice-making machines capable of making 5 tons of ice a day	20,000
20 Fishing boats to fish in the rivers @ Rs. 200 each	4,000
40 Big nets to catch fish @ Rs. 20 each	800
	Rs. 84,800

This amount of Rs. 84,800 or say Rs. 85,000 will have to be spent for buying the necessary steamers and boats for catching and bringing the fishes caught to Calcutta. To man the steamers and the fishing boats there will be the following additional expenses, *viz* :—

2 Headmen or *serangs* to guide the steamers @ Rs. 50 per month	100
2 Engineers	200
4 Fire-men @ Rs. 15 per month	60
40 Crew @ Rs. 12 per month	480
Coal 3,000 maunds a day @ 6 annas per maund	1,025
Other expenses	200
	Rs 2,065
5 Men per fish boat will be sufficient to man the boats and catch fishes @ Rs. 12 per month—60 per boat, or in 20 fishing boats the expenses will be	1,200
Other expenses, as repairs, etc., etc , ...	200
	Rs. 1,400
Add to it the interests on Rs. 100,000 per month @ 6 per cent., Rs.	500
	Rs. 3,965

Thus, everything considered the expenses will be about Rs. 4,000 per month. Now let us see what may be the monthly income of such an enterprise, it being taken for granted that there will be a ready sale of about 12 tons or 320 maunds of fish, every day for cash.

Taking the lowest value of the fish to be Rs. 10 per maund, (the retail sales are always effected to good fishes @ ans. 8 per seer or Rs. 20 per maund) the quantity will fetch Rs. 3,200

Thus we see that daily income of such an enterprise is about Rs. 3,000 or one day's income may nearly pay all the expenses, keepin 29 day's income for profit, which no other trade in this world is expected to pay.

The question may be asked as to whether there is such a demand as to find market for 12 tons of fish every day. Calcutta is such a big distributing centre and the demand for good fish, preserved in good condition, is so great that there will be no lack of ready buyers for 320 maunds every day. Besides, most of the fishes are now brought down to Calcutta by rail and are generally dead and putrid when they arrive at the market. But in a steamer, it can be easily managed to keep sufficient water in the hold to keep the fish alive for 12 or 24 hours, if caught alive and transfered from the boats to the steamers with care. There will be sufficient ice on board, besides, to keep the fish in good condition. Steamers or boats are, by nature, the best conveyances for fish. It is doubtless that fish, if

brought down in steamers, will reach in better condition, than in Railway wagons and therefore there ought to be a far greater demand for the fish brought down in steamers.

A company can very well be started on the joint-stock principle, a share being fixed at a rupee each, so that even the poorest may have a share in the income, which is expected to be about 100 per cent. per month or as much as the capital invested. Thus a shareholder investing one rupee in the business may get nearly a rupee every month, enabling a poor man to live comfortably, if he has but 10 or 12 rupees to invest. To stimuate an active interest in the concern among fishermen, who are the chief selling agency, shares may be liberally offered to them.

FISH AS MANURE

"Fish manure is not so widely known, but the demand for manure in the Deccan, and probably other parts of India not far removed from the coast, is so great that a trade in Sun-dried refuse-fish has sprung up. It is a concentrated manure, containing fully 10 times as much plant-food per ton, as farm-dung. The amount employed (experimentally on a suger-cane. plantation) was 2·7 to 2·9 tons per acre containing about 500 lbs. nitrogen, and the out-turn of raw sugar varied from 11,000 to over 13,000 lbs."
—Report of Mr. J. W. Leather, Agricultural Chemist to the Government of India.

IMPORT OF FRESHWATER FISH

Holland has so few freshwater fish that their importation is profitable. A Dutch importer, of Woerder, has just left Lyons for Utrecht with a quite an original cargo in a quite original boat. The cargo is composed of 25,000 tench, carp, and other live freshwater fish in tanks, and the boat is a specially constructed automobile barge, driven by benzine, and of about 18 horse-power. The merchant himself and his "chauffeur" are the whole crew, the merchant spending his time feeding the fish. It will take 20 days to reach Utrecht through the canals, 250 locks having to be cleared.

THE FISHING INDUSTRY OF JAPAN

AN OBJECT LESSON TO INDIA

(*a*) *The Fisheries Bureau at Tokyo.*—The fish existing in Japanese waters, are very varied and very plentiful; the most useful kinds in the northern part of the Empire, are the herring, salmon, and cod. In the southern waters are found the sardine, anchovy, mackerel, homito, tunny, shark, oysters, shrimps and prawns. The fresh water fishery is not so important as the marine fishery, as there are but few large lakes and rivers. In the warm seasons, nearly the whole coast of Japan is washed by the Kuroshiwo (the warm current), or its branches. Thus the important migrating fish of the southern region are caught in the northern part of Hondo (main island), and also in Kokkaido, late in the summer or in the autumn. In the winter and spring, the Kuriles, Hokkaido, the north-eastern and north-western coasts of Hondo, are washed by the Oyashino (the cold current) or its branches. The number of vessels engaged in fishing on the Japanese coasts is said by the Imperial Fisheries Bureau of the Department of Agriculture and Commerce at Tokyo, to amount to over 400,000.

(*b*) *Trade in fresh-fish.*—Fish are sold fresh in enormous quantities in Japan, and fresh-fish markets are extended year by year as the convenience of transportation increases.

Considerable quantities of fish are also preserved, and many kinds of fishery-products are utilised to a degree not equalled by many other countries. The most important sea-weeds are "kombu," "amanori," "tengusa," and "funori." The greater part of the dried kombu is exported to China for food. Tengusa is made into a kind of isinglass called "kanten," and the kanten is also exported to China and other countries in large quantities. Amanori is made into sheets like paper and dried. It is called "hoshimori," and is considered a great delicacy. Funori is also made into large sheets like paper and dried. It is used only for starch.

(*c*) *Brine-salting or curing and canning.*—The methods of curing fishery products have greatly improved of recent years. This is especially seen in the canning business which was introduced some thirty or forty years ago, and has grown considerably since the Japan-China War. Every year, a little over five million pounds of fish of all kinds are preserved in tins. Brine-salting, or curing fish in strong brine, has been introduced recently, the salting of fish being formerly

confined mostly to dry-salting. This has made it necessary to improve the Japanese salt-industry, in order to obtain a better quality of salt. As to the export-trade, dried cuttle fish, dried "sea-ear," dried shark's fin, dried kombu and kanten are the most important articles exported to China. The exports of Japanese fishery products, has long since been in a prosperous condition, the exports always exceeding the imports. The total exports to China have increased by three million *yen* (£306,250) within the last ten years.

(*d*) *Fish-oils.*—Fish oils, including herring, sardine, cod-liver and whale-oil, are exported to Europe in large quantities.

(*e*) *Pisci-culture.*—Pisci-culture in Japan includes the culture of fish, shell-fish, reptiles, and even algæ. Some of these have been cultivated from ancient times. Among these are the gold-fish, carp, eel, grey mullet, oyster, pearl-oyster, turtle and amanori (an alga of the genus Porphyra). Most of them are cultivated in ponds, except shell-fish and algæ which are rared in a bay or creek.

The cultivation of amanori which is known only in Japan, is extensively carried on in Tokyo Bay and the Sea of Haroshima-Ken. This sea-weed is collected by means of the branches of trees or bamboos, driven into the sandy flats, which are exposed at the time of the ebb-tide. To these spores of the alga attach themselves and grow. These branches are renewed every year.

Funori is also cultivated in a primitive but effective method in some parts of the country. This is by simply throwing stones in the shallow water to give the alga a place to grow on.

Carp-culture is the most popular of the artificial fishing industries. It is carried on to a large extent in ponds, and sometimes even in rice fields.

The culture of the soft-shell turtle is limited to one place in the suburbs of Tokyo, and requires very considerable skill.

The artificial propagation of salmon has also been practised. In the year 1878 the Agriculture Bureau collected the eggs of salmon in certain rivers in Mugata-Ken, Nangano Ken, Ibaraki Ken, and Hokkaido, and distributed 356,500 fry into many rivers and lakes and in 1890 the number had increased to 1,130,000 but without much success. There appears, however, to be one place which shows good results from this work. It is Lake Chuguji in Nikko, where there were no fish at all before the propagation of salmon. The quantity of fish in this lake is now so great that it supplies an abundance, and it affords excellent sport for anglers.

(f) Experimental stations.—A Fish Commission was appointed in 1,893 to carry on more extensive scientific investigations relating to all branches of the fishing industry in Japan, and this Commission lasted until 1898. In that year the present Fishery Bureau was organised, and the work has since been carried on more scientifically and systematically. While this work has been carried on by the Central Bureau, the Government has for a number of years encouraged the establishment of local experimental stations, and has given a bounty to each of them. As a result, there are now thirty-two experimental stations distributed among thirty-one perfectures.

(g) Fishing Schools and Fishery Institute.—Fishing schools have also been started in different parts of the country. TheGovernment also founded a school in Tokyo in 1897 called the Suisan Koskujo, or Fishery Institute. There are a few private Associations organised with the object of uniting those interested in the fishing industry, and of studying all the important subjects in connection with fisheries. Among these the Fishery Society of Japan is the oldest organisation. It was founded in 1881, and now has nearly five thousand members. This society publishes a monthly journal. There is another Association called the Society for Salt Industry of Japan which devotes itself to the improvement of the salt-industry. It was established in 1896, and also publishes a monthly journal for its 1,500 members. Both of these organisations are situated in Tokyo.—JOURNAL OF THE SOCIETY OF ARTS.

The fish available in the rivers and seas of India, particularly Bengal, are varied and plentiful—a huge amount of which simply goes to waste all the year round for the want of a better use.

There is much to learn from Japan in this line as in many others.

Sir Frederick Nicholson is just now in Japan to make a thorough study of the system on the spot, with a view to utilise his experience in India.

THE LONDON SYNDICATE AND THEIR NEW INDUSTRY

A Company, a very wealthy London Syndicate, with well-known and wealthy people as its subscribers—and not mere company-promoters—has been floated with the object of developing an industry and to take a risk in fishery in Ceylon.

The Syndicate means to go in for quite a large fleet of steamers, to bring a large amount of capital into the island and to develop not only the pearl fisheries, but, to create a new industry in Ceylon, that is, to develop the resources of the Island's fish supply as it has never been developed before. They intend, incidentally, to go in for fish trawling in co-operation with native fisherman, and bring indirect as well as direct profit, which the rent of the fisheries will bring to the Government. The steamers will be of special design, suitable both for trawling and for pearl fishing, and native divers as well as native fisherman will be employed."

THE NEW INDUSTRY

The fish supply of Ceylon, as indeed of all eastern countries, is an important factor in the lives of the people. At the present time a tremendous amount of salted fish is imported into Ceylon. The London Syndicate will introduce a large amount of capital and develop local resources in such a manner as to render importation unnecessary. Curing yards will be opened, and employment found for a large number of natives. The fishing will be done by trawlers as at home.

A TIMELY WARNING

The Syndicate is evidently trying to secure a monopoly of the fisheries in the East,—says the "Madras Mail" As already stated, they have approached the Madras Government regarding the lease of the Paumben pearl fishery and now the news comes from Burma that during the year, application on behalf of the same Syndicate was made to the Burma Government for a similar lease of the Mergui fisheries and for pearling rights in a block off the coast of Tavoy. They are arranging to secure a monopoly of the fish supply too.

In response to a requisition from European merchants, Hon'ble Mr. K. G. Gupta, Member of the Board of Revenue, is placed on special duty by the Bengal Government to make enquiries as regards the possibility of improving and developing the fisheries in Bengal. Probably, the sea fisheries can be greatly developed, while, in its river system, Bengal has sources of fish supply, perhaps unrivalled in the world, and efforts should be made to conserve and develop the fisheries of Bengal on modern and scientific lines.

There is yet room for indigenous capital and enterprise in this direction and we should not wait to be swamped by foreign competition, which may take place any day, as it has already done in Ceylon.

THE FISHERIES INVESTIGATION

[Sir Frederick Nicholson's interesting and suggestive Reports]

The report of Sir Frederick Nicholson on his investigations into the Sea Fisheries on the West-Coast is, as was to be expected, full of interest. Of course, there has never been any doubt that there is a potential industry and a store of wholesome food lying neglected in the sea round our coasts. Sir Frederick Nicholson gives the reasons very clearly why progress has not hitherto been made. Briefly stated, there are the difficulties in the way of keeping fish, in a tropical climate, untainted, till they reach the curing yards and then there is the usual want of enterprise found in the hereditary castes who alone carry on fishing operations. With modern scientific knowledge and appliances, the first difficulty will be easily overcome and it seems only to want the energy and capital of an enterprising firm to reap a fortune out of the sea. Besides the tons of food that lie wasted along-side of a country periodically smitten with famine, there are stores of wealth in fish-oils, manure and the other by-products of big fisheries. Fish-oil from sardines alone is said to have been formerly exported from Cochin in a single year to the extent of 150,000 cwt. There seems to be some doubt whether these figures are accurate, but there is no doubt that there was, at one time, a considerable trade which has now completely disappeared. Among other neglected products of the sea is mentioned the porpoise hide, which is now not even removed when a porpoise is accidentally caught. The cat-fish on the other hand give their heads to the toddy shop keepers who cook them with condiments and sell them as drink provokers, and their entrails as nutriment to the poorer classes, who can buy them for one pie a basket and then eat them boiled with salt and chilies. These are some of the minor points of interest noted in this most instructive report.

The main question which Sir F. Nicholson sets himself to answer is, how the fishing arrangements can be improved and the fish cured. At present, there are no big boats employed in the trade, and in consequence it is impossible to do any curring on board or to keep the fish alive in tanks. For these reasons there is no real deep-sea fishing done at all and only the fringe of the shallow coast is exploited, so that it is not really known what the supply of fish is likely to be. It is true that the bottom is singularly devoid of

sea-weed which is so important as a shelter for fish and a supply of food, and this in itself might be taken as presumptive evidence against large supplies of fishes, but on the other hand sharks and other predaceous fish are so numerous that of necessity they must have an enormous supply of food to draw on. The report shows the advantages that trawlers would have in these tropical waters over their fellow-workers in the Atlantic or North Sea. In the first place there is a continuous shelving bank, down to thirty fathoms; from there it slopes more steeply to 100 fathoms, ending in a precipitous cliff. Within this 100 fathom limit, which has an average width of forty miles, there is a smooth bottom of sand mud or ooze, admirably suited to a trawl net. For eight months in the year, from October to May, there is, as a rule, continuous fair weather, with none of those sudden tempest that so often desolate the homes of British fishermen, and nature is obliging enough to supply in the early morning a wind off the land to take the boats to their work, and a steady breeze from the sea throughout the day to bring the boats home again in the evening. Another arrangement of Providence that falls in with the schemes of exploiting man is that the sardines and mackerels which are known to exist in vast shoals, though they by no means invariably come in shore, have their spawning season in July and August when the S. W. Monsoon would prevent any trawling being done. But as we have said before, the whole success of the future industry depends on the time, element or interval between capture and curing. In the past, this has practically destroyed any spirit of improvement. It is recorded that on one occasion a catch of fish worth Rs. 8,000 was taken to the fish curing yards after 10 P. M., when it was found that the yards were closed for the night, and by morning the whole lot was bad. There is a contrast here between our old world oriental methods and those of the far west, where, in British Columbia, the salmon are cleaned, cut up and tinned within twenty minutes of their coming to shore. We do not expect to see any such lightning reforms flashed over the mediæval customs of Malabar, but by degrees, a change of method must come, and Sir Frederick Nicholson suggests the lines. The following are some of them:—The use of bigger boats of two or three tons which can stay at sea for two or three days and be equipped with live wells, salt or preservative processes. The drying process should not be left to the intermittent heat of the sun, but should be

continued artificially through the night; the fish should be smoked in kilns with wood and paddy husk fires; the fish could be packed in salt in closed barrels; or canned as is already being done, we believe by a French manufacturer at Mahe, or reduced to meal by rapid artificial desiccation. But we do not think that these suggestions will have any effect on the fisher folk of Malabar. They will not sail out in trawlers, neither will they improve their methods of curing. Improvement must come from enterprising capitalists, and there are apparently signs that the industry is already moving slowly, though very far behind the times of syndicates, but still beginning to move from the age of the individual fisherman to a development of combinations of men working for wages as the servants of small capitalists.

FISHERY LEASES IN BURMA

People interested in Indian Fisheries may be interested to learn that the Burma Government are disposing for one year, with effect from 1st July 1906, of the following leases and license in the Bassein District :—(1) A lease of the Turtle bank at Diamond Island Pearl Fisheries in the Ngaputaw town-ship; (2) a license to collect edible birds' nests at Sumia Island in the Thabaung township; and (3) a lease of the fisheries of the Bassein town-ship.

Sea-fishing, writes a correspondent to a Rangoon contemporary, is an industry which would doubtless be very remunerative here if capital was forthcoming for it. In other parts of the world, steam trawlers have revolutionised this industry. On the Burma coast, the same description of boats are used, as when Tenesserim, was first annexed eighty odd years ago. It is hardly surprising that, although there is an immensely increased demand for fish, the industry has not made much progress. Advances made by Government last year to those employed in sea-fishing were recovered with difficulty.

A FISH HOSPITAL

SOME METHODS OF TREATMENT

It may seem strange that fish can be treated in a hospital, but this forms a very important addition to the New York Aquarium, which is one of the largest in the world. This hospital, says "Chambers's Journal," contains fish from nearly every country on the globe, including the species which live in fresh-water as well as in salt-water,

and ranging from specimens a few inches in length to great man-eating sharks as well as black-fish. Where so many varieties are kept in confinement, it is a well-known fact that, they frequently become injured or afflicted with some disease. Unless of an unusually hardy variety, they seldom recover from the trouble, dying sooner or later. For the purpose of healing injuries and relieving the fish of any disease which they may contract, this curious hospital has been arranged. It is divided into regular wards—tanks of water. One is for fish suffering from contagious diseases, so that they can be kept from others. Of course, the larger fish are kept by themselves in a "ward" of suitable dimensions. Another ward is provided for those recovering from their ailments; while the "surgical" cases, as the fish-doctor calls them, are likewise kept by themselves.

Since the hospital was opened, the doctor and his assistants have learned some interesting facts. One is that salt-water is an excellent remedy for many diseases of fresh-water fish, and, if they are left in the salt-water a few days, or possibly, weeks, it often heals sores caused by their striking the aquarium walls or other fish, as well as the growths of fungus, to which smaller fish especially are very susceptible. The salt-water is obtained directly from the ocean, but is weakened by mixing it with a certain proportion of fresh-water, and it is also kept at a temperature about the same as that of the water from which the "invalid" was taken. On the other hand, if salt-water fish are treated to an occasional bath of fresh water of the right temperature, it has been found very beneficial for them. The most common disease among fish is the growth of fungus. If not properly treated, the fungus will spread over the body of the fish till it dies. A wall-eyed pike, for instance, had its gill and one side of its body almost covered with fungus when it was taken to the hospital; but the disease soon showed signs if yielding to the treatment. Pickerel are the most susceptible to fungus formations. The common brook-sucker is the most stubborn in yielding to treatment when disease has once taken possession of it. Trout and salmon were formerly troubled very little with disease, but they are now seen in quite large numbers under the care of the fish-doctor.

The carp is an exceedingly hardy fish, and is seldom sick. The gold-fish is usually in good health, but occasionally has inflammation of the gills. This is precisely the same affection as inflamation of the lungs in a human being, and leads ultimately to consumption and death. When

the gold-fish once gets this disease there is no cure for it. Many fish of different varieties are often placed in the same tank in the ho pital, but none of the patients attempt to make it unpleasant for the others. Some of the fish are treated for wounds they receive in fighting. The surgical operations form the most remarkable treatment of the fish sent to the hospital. In very bad cases of fungus growth, the foreign substances are removed by the knife. Sometimes abcesses are lanced, but it is seldom that these operations prove successful, and they are only resorted to in extreme cases. Frequently, however, fishes are operated on when their air-bladders fail to perform their functions. A deep-sea bass lost complete control of his air-bladder. Of course, he was helpless. He turned over on his side and could not sink, as the sac was filled with air. He would have soon died in his helpless condition, as his gills were above the surface of the water. The bass was taken up carefully and a surgeon's needle inserted, just behind the pectoral fin into the air-bladder. The air escaped, and the bass was again able to manage himself. A few days in the hospital tank healed the puncture in the air-bladder, and then he was as well as ever.

SHELL-FISH SILK

Sicily supplies a curious silk which is spun by the *puina*, a Mediterranean shell-fish, which has a little tube at the end of its tongue. Out of this tube, spider-fashion or silk-worm-fashion, it spins a silk thread, with which it fastens itself on any rock it fancies. When the *puina* moves on, its silken cable remains behind. This cable, which is called *byssus*, the Sicilian fishermen gather. *byssus* weaves into the softest and shinest of fabrics, but it is very rare and expensive.

PALCUNA OYSTER OR A SUBSTITUTE FOR GLASS

The shells of this mollusc are said to be used on account of their clear translucency as a substitute for window-glass in China and in the Portugese territory of Goa—whence arises the term 'window-oyster' as applied to this species, the '*Vitre Chinoise*' of French writers. The reason for the fishery of these Oysters lies, however, entirely in the abundance of small pearls yielded by full-grown ones.

Some distinct Palcuna beds have been discovered in Tamblegam Bay, Trincomalee.

TROUT-BREEDING IN CASHMERE

Successful trout-breeding operations were carried out in Kashmir last year. Over 30,000 ova were obtained last December, 25,000 of which were hatched out. The operations were conducted by Mr. Frank Mitchell who has been given a sum of £100 by the Maharajah in recognition of his services. Trout-culture has now become a State enterprise in Cashmere, and is under the Secretary of the Game Preservation Department

TROUT-CULTURE IN THE NILGIRIS

A great deal of interest is being taken in Ootacamund in the important experiment that is now being made to stock the Nilgiri waters with trout from Ceylon. Mr. Wilson, the expert of the Ceylon Fishing Association, brought up 100 yearling trout last week. He had all his fish alive after completing more than half of the journey from Madras, but unfortunately at Erode there was no suitable water available for filling his tanks, and he lost more than half his trout. He arrived in Ootacamund with 37 healthy fish, a remarkable result when the length of the journey and the heat and enormous difficulties of the task are taken into consideration. He has since been over the neighbourhood with the Hon'ble Mr. H. P. Hodgson, who is taking a foremost part in the arrangements, and Mr. A. B. Jackson, the District Forest Officer, and the trout have been put into the stream running through Parson's Valley. A meeting of the local Game Association is to be held on Thursday, to hear Mr. Wilson's views on the subject of trout prospects on these hills. He has great hopes of success in his experiments.

IMPORT OF CORAL

There is a large demand for coral in India, and buyers from Nepal and Tibet are willing to pay exorbitant prices for good qualities. Nevertheless, the supply imported through Bengal ports fell to 126,023lbs. or by 29 per cent. As a matter of fact, artificial coral is now a severe competitor with the natural article, which is perhaps not a bad thing since the natural supply seems to be failing. The demand for the artificial product grows steadily, and last year the imports were valued at well over three lakhs of rupees.

TRADE IN RAW MEAT

There is a regular trade in raw meat preserved in ice from Australia to Europe which brings a good profit. Some special steamers are about to be used for purpose of extending the trade to Japan and China.

SALMON REARING

The attempt to rear the five thousand salmon ova of the steelhead species recently imported by Mr. Loesch of Nuwara Eliya, has not proved successful. This does not necessarily indicate that the Ceylon climate is not conducive to salmon breeding, their failure being evidently due to the adverse climatic conditions which happened at the time of the receipt of the consignment. Mr. Loesch received a consignment of 15,000 rainbow trout ova at the same time as the salmon ova, and it is understood that, despite difficulties in the way, a moderate percentage have hatched out.

TRUFFLES GROWN ARTIFICIALLY

Science has achieved another triumph, which will affect the food-supply of the world to a considerable degree and cause immense happiness among a great body of gourmets and lovers of good living. M. Emile Boulanger, of the Institute of France, has succeeded in cultivating the famous truffles of Perigord by a process which is almost equivalent to artificial germination.

Hitherto truffles have only been found wild, and it has been impossible to cultivate them by transplanting or by any other of many methods which have been tried. The truffles of Perigord, which are the only ones that are greatly in demand, will not grow anywhere but in this district of France. It is well recognised that there would be a handsome fortune for many American farmers if they could be grown elsewhere, but that has hitherto been impossible. Truffles are a valuable article of food, containing a high proportion of nutritive bodies. Many thousands of people consider them the most delicious of all flavorings for sauces and many dishes. They cost as a rule 3 a pound in France and that places them above general consumption.

A simple and entertaining but very lengthy process of obtaining the natural truffle is at present employed. The pig has an unerring scent for truffles. The farmer puts a ring in the nose of a lively and intelligent pig and takes him out walking. Presently, Mr. Pig

arrives at a spot where a truffle is buried, often two or three feet in the earth. He tries to dig for it, but the ring prevents him. The farmer quickly throws up the earth with his spade, pockets the truffle and continues the search. Occasionally he gives a slice of the worthless outside of the truffle to the pig in order to quiet his discontent.

By microscopical examination M. Boulanger discovered the germinating property or seed of the truffle which had never been isolated before. This property lies in the spores of the transparent asci of the root. He planted these on various nourishing substances such as bread, potatoes and carrots, and finally he found that they grew upon beet-roots, which contain an enormous proportion of sugar—a substance necessary to the growth of the truffle. He placed these beet-roots in bottles, sterilized and constructed in such manner that they would admit the free passage of fresh air but prevent the entry of microbes. Upon the beet-root developed the spawn, or mycelium of Perigord truffles, and after that small truffles. The spawn when planted developed into excellent truffles, and there is every reason to believe, that it can be planted in other parts of the world, where the climate and soil are suitable.

"I have now 3,000 bottles of truffle spawn in my laboratory," said M. Boulanger to a correspondent. "As to the extent of my Etampes champs d'experience, which I shall be glad to show you any day you like to go there with me, they cover many acres of calcareous soil planted with small oak trees. It is beneath these that the mycelium, after it has been manipulated in a manner which I will explain to you on a later occasion, is planted; and whenever I have a favourable result a number is attached to the nearest tree."

Finally, M. Boulanger expressed his opinion that the economical cultivation of truffles would in time become as easy as the growing of mushrooms.

TURTLE FARMING AS AN INDUSTRY

"C" writes in the "Capital":—

It may be that the marine turtles found on the Indian coast and in the Indian seas, may not be as highly esteemed for the delicacy of their meat as the turtles imported into Europe chiefly from the West Indies and including the green turtles that yield the materials for the celebrated soup, on which British aldermen are proverbially fond of feasting, but it

is quite correct to say that we have edible turtles of very fair quality that would repay attention of enterprising capitalists, in respect alike of carapace, meat, oil and gelatine. On the coral-gird islands in the gulf of Mannaar, the Indian Green turtle is largely to be met with. It deposits its eggs on the sandy shore, where it is by no means difficult to gather them. From this species as well as from the Indian hawks-bill turtle, the best tortoise shells are obtained. On the Malabar Coast, the Indian logger-head turtle is to be met with, largely off the Laccadive and Amindivi Islands. In former years, this species was largely captured, mainly for the sake of its shell, but the shell has no great commercial value. Within the past few years, very few shells have been taken over to the mainland. The Indian loggerhead turtle, it may be mentioned, is a carnivorous creature, living on fishes, mulluscs and crustaceans. Although its flesh is not much esteemed as food, its oil has a considerable commercial value, much of the turtle-oil which finds its way into the market being obtained from the Atlantic species of this genus. As for the hawks-bill, though it does not reach the same size as the other turtles, its capture is very profitable, since it yields the best shell. It is more abundant in the Indian than in the Atlantic Ocean, but is plentiful only in certain localities, where it regularly returns to propagate its kind. We have also the Indian turtle—"Chelonia virgata"—which is a herbivorous creature, that feeds on algæ. It is allied to the celebrated Green turtle of the Atlantic, and there are those who maintain that its flesh rivals that of its Atlantic relative in favour. This of course, is a moot point, though what is certain is that the Indian Green turtle's flesh has sometimes been found to be poisonous.

The natives of this country have from remote times turned our marine as well as land turtles to use, consuming the flesh of certain varieties and converting the carapaces of others into combs and other useful substances. For the latter purpose, the shells of the green and hawks-bill turtles are chiefly requisitioned. There has, however, been no regular industry either in the way of turtle fishing or turtle farming, and to have some idea of what can be done in the latter direction, we have only to refer to the very profitable suppon or snapping turtle farm near Tokio, owned and worked by an enterprfsing Japanese family. The suppon turtle occupies in Japan the place filled by the terrapin in America and the Green turtle in England, and on the

farm near Tokio, several thousands of these Chelonians are turned out every year. The farm consists of a number of rectangular ponds, some of them from 25,000 to 50,000 square feet in area, the depth of each pond not exceeding 3 feet, and a plank wall being run all round to prevent the escape of the turtles. The bottom of the pond is covered with soft mud, where the captives may hybernate during the winter, while a few feet of slope above the water, and reaching back to the wall give the turtles sufficient opportunity to come out and bask whenever they choose to do so. One of the largest ponds is reserved for breeding, the female turtle laying her eggs in a hole dug by herself on the bank, above the water line. First year and second year turtles have to be removed into separate ponds, as turtles have cannibalistic tendencies and the grown-up creatures devour the young ones with avidity and without any compunction. The food of the turtles reared in the farm is most carefully selected, certain species of shells, scraps of dried fish, boiled wheat, grain and the pupa of the silkworm moth being chiefly given. It is also found that the turtles thrive better if carps and eels are bred in the ponds, and this is said to be because the fish keep the water stirred up and thereby afford encouragement to the turtles to sally forth in search of food, turtles being timid creatures that hardly venture out, except under compulsion, in clear water.

In parts of India and Burma, there is now a considerable industry in pearl and edible oyster-catching operations, although such a thing as oyster-culture on scientific lines is virtually unknown here. In Japan, they have not only turtle-farming, but oyster culture, fish culture, and even the culture of sea-weeds, each of these industries being on an extensive scale and improvements being intrdouced from year to year. It is the fashion now-a-days among our friends of the native press and the "ultra" radical platform to wax eloquent about imitating the Japanese nation. The directions I have mentioned are among those in which Indians could most advantageously imitate the Japanese, and I think, as a *Swadeshi* industry, turtle farming ought to appeal forcibly to patriotic Indians. We may depend upon it that, some day or other, the European will turn his attention to this matter, more especially, if the present *Swadeshi* movement restricts the field of European enterprise in India. For my part, I would feel quite well pleased to find turtle-farming on our Indian coast and in our island groups seriously taken up by Europeans,

but I see no reason why Indians themselves should not embark upon the enterprise. We may be sure that a little time spent in Japan would enable the intending turtle farmer to study "the bricks of the trade" and come back here and set up his own sign-board.

TRADE IN FROGS

A Lucrative Business with Nominal Capital

There is a belief among Indians that nothing comes amiss to Westerners in respect of food. In India, it is only the savages and barbarians, such as Sonthals, Coles, etc., who ever take frog, lizard and the like. But in the West, frog is a national and much relished food. Here is a para. which is being quoted and requoted in the Western press:—"There are few more remarkable industries, surely, than one which is carried in Canada, at Bensford, Ontario, where there is a farm which is devoted to raising frogs for culinary purposes. The farm at Bensford furnishes to the markets of the United States over 50,000lbs. of dressed frogs' legs annually, while another 30,000 are disposed of the province of Quebec. The plant necessary for an experiment of this kind is small and inexpensive. What is mainly needed are shallow ponds, and they require no attention, except the planting of bushes around the edges. These serve to attract flies, and are also a protection against enemies. Frogs live mainly on insects and flies, and it would probably be found that the Fen District is as well adapted as any in England for the purpose of raising them."

"Max", the well-known writer in the Capital, says that there is money in frog's legs. We are told that frog trade is growing to great and still increasing dimensions in America. St. Paul and Minneapolis are the great centres of the trade and frog legs are purchased all over the States for shipment to these two cities. Five years ago, there was no such trade. Now the business amounts to upwards of Rs. 3,00,000 a year, requiring the slaughter of no less than 50,00,000 frogs. In nearly every considerable hotel frog legs are to be found on the bill of fare. In New York they cost from thirty-five to fifty cents per dozen. One leading New York Hotel uses up fifty dozen per day. The frog-catchers in America make each about Rs. 9 to Rs. 30 per day during the season, and there is a continuous demand for all they can catch. They use the

legs for food instead of chickens and the skins are sought after for bookbinding. In India, we have enough frogs to spare and as there is no demand for home consumption a lucrative business can easily be started by enterprising men with a nominal capital. We hope some of our young and energetic men will profit by the noble suggestion of "Max."

Poultry

POULTRY FARMING IN INDIA

An Important and Profitable Industry

Not too early in the day, has attention been called to the desirability, nay the necessity of establishing poultry farming as a national industry in this country. From several provinces, north and south, east and west, comes the cry that the time-honoured "moorghi" is becoming far less abundant, more expensive, more attenuated and considerably less palatable than it was half a century, even a quarter of a century ago. I am acquainted with several localities in Southern India, where the price of a small-sized, under-fed and scarcely toothsome, country-fowl has risen during the last two decades or so from three or four annas at the utmost to practically double this amount, and where a corresponding increase has taken place in the market value of fowl's eggs. It was stated very recently, with particular reference to poultry in Northern India, that the supply is slowly but surely giving out, and it would seem that something of the same sort is going on in Southern and Western India also. The rise in the price of poultry and eggs is no doubt partly due to the general rise in the price of food substances, but I fear it is also due in part to the decline of poultry-farming in several parts of the country, among the Natives, who never, at any time, pursued this industry on either a systematic or a considerable scale.

At the present day, there is certainly a fair amount of poultry raising for profit to be found, carried on near our largest centres of population, chiefly European and Eurasian population, and in the poultry stalls of cities, like Calcutta, Madras and Bombay, fowls of various creeds as well as ducks and turkeys, are obtainable at all seasons of the year, even if quality is not always proportionate to the prices demanded. But even in these cities, there is still plenty of scope for the expansion of the poultry-farming industry, while over the rest of

the country, where poultry alive or dead and eggs are to be classed as important articles of diet, poultry raising would not only prove remunerative to those who are persuaded to take to it, but will sooner or later have to be recognised as one of those industries which are almost in the nature of national necessities. In most of our hill districts as well as over a considerable proportion of the low country, the conditions are undoubtedly favourable to the profitable farming of poultry on a large and commercial scale. In such hill districts, as the Wynaad, Coorg, Shevaroys and Nilgiris, the conditions are almost ideal. The climate favours the raising of good breeds, and there is sufficient land available, with enough water in the neighbourhood, for extensive poultry farms; accommodation for buildings, land for runs, etc., all being readily available. In many parts of the low country especially in those which are served by rivers and streams or are provided with the lagoons peculiar to the South-West Coast of India, it should be quite possible to establish very extensive and lucrative duck-farms. So far as Southern India is concerned, there is fair amount of duck-farming in the neighbourhood of Cochin, in the Coimbatore and Trichinopoly Districts and in a few other localities, but everywhere, the industry is on a haphazard and unsystematic scale, and the duck farms of Southern India must not be looked upon as resembling, ever so slightly, the remarkable duck-farms of, say, Suffolk, in England. Just at present, there is some talk of introducing the Chinese method of duck-raising into parts of the Madras Presidency and there is good reason for hoping that, should the industry be established, it will, in the course of time, prove a great source of profit.

Poultry-farming is to be strongly advocated in India, not only because the existing supplies of poultry are beginning to be found inadequate to meet home requirements, but because such farming, if carried on as it could and should be, would, in the course of time prove a source of much wealth to the country through the creation of an export-trade in poultry and poultry products. In Europe and America, at the present day, poultry-culture in one form or another is a really important industry in which much capital is invested. Great Britain does a considerable amount of poultry-farming and egg production on her own account, and yet, she finds she has to import millions of sterling worth of eggs and poultry and game. In 1904, her egg imports were valued at

£6,730,574 and her poultry imports, living and dead, at £1,217,277. She obtains her imports from the United States, Canada, several European countries and elsewhere, and within recent years, the Australian Colonies have also secured a fair amount of the British trade. Indeed, poultry farming is developing rapidly in Australia, and around Sydney, there are now numbers of poultry and duck farms which supply their best export fowls for the London Market. Tasmania, too, has started a poultry farm, which is maintained by the State, both for the improvement of stock and for affording instruction in poultry breeding.

In France, Belgium, Denmark, Germany, and even Russia, great and increasing attention continues to be paid to poultry-farming and the industry is everywhere considered an important source of national wealth. In the Dominion of Canada, poultry-farming is now one of the most important national industries, and, especially in the matter of eggs, the exportation is going up every year by leaps and bounds. Canadian eggs are usually placed for export in cases containing 30 dozens each, and card-board fillers are used which provide a separate compartment for each egg. There are cold storage warehouses at various points in the Colony, at which eggs are collected, sorted, and packed before shipment. These arrangements enable the eggs to be landed in Europe in a practically fresh condition as regards flavour and with the shells quite full. Canada is every year finding Great Britain a larger customer for her poultry and eggs, and while other Colonies also are serving the mother-country in this respect, slow moving India, once reckoned the brightest jewel in the British Crown, is apparently taking no heed of the fact that this proud position is being slowly, yet steadily, usurped from her by other British possessions. In fact, India has an inconsiderable export-trade in poultry and poultry products. Taking the Madras Presidency, where the conditions in several parts are very favourable for poultry-farming on a commercial scale, we find that the value of the poultry and game exported in 1904-1905 was no more than Rs. 84,841. A comparatively backward country like Morocco annually exports eggs alone of the value of about £75,000.

But after all, it is to the United States of America, we must go to realise what remarkable results can be accomplished by careful, systematic and scientific attention to the great industry of poultry breeding. The value of the poultry raised in the United

States in 1899 was nearly 137 millions dollars and that of the eggs produced over 144 million dollars. As for systematic breeding, on the principle of selection, it may be mentioned that, a few years back, one American breeder obtained an average of 196 eggs per annum from as many as 600 White Leghorns and another breeder 194 eggs from 140 Plymouth Rocks. With regard to Mammoth poultry farms, it may be mentioned that one of the largest single establishments in the States is the Meadow-brook Farm, in Pennsylvania, occupying 80 acres, with several hen-houses, one of them 1,000 feet long. This farm sent to market in one year 25,000 chickens and 20,000 ducklings, in addition to selling many stock-birds and an enormous number of eggs for hatching. There is an establishment in Ohio, whose daily demand for eggs for incubation is reckoned in thousands. One order for 20,000 eggs was received in a single day in March, 1901. Quite recently, a New York paper described what is believed to be the largest egg farm in the world. It is in Hancock, V. H. It has over 8,400 hens, kept in 600 small houses, fourteen in each. The hens average 100 eggs each during the year, for which the high average of 26 cents a dozen is received. The profit on each hen is said to work out to about one dollar. The droppings go to fertilise a large orchard and are a source of profit. Only young hens are kept, the second year they are sold, and pullets bought for the next year's egg-crop. Mammoth farms like these are the exception, not the rule, but moderate-sized farms are very numerous, and intelligent farmers reckon to make a profit of a dollar a year on each head of their laying or breeding-stock.

In fact, experienced American poultry raisers favour the starting of farms on a moderate scale and increasing the business gradually as custom increases. At the present day, it will be found in a very large proportion of cases that the big poultry farm which is succeeding is, that one that began in a small way as a side line and was built up gradually and slowly. On the other hand, I could cite several instances of considerable sums having been lost in attempts to start poultry farming on a gigantic scale. For the present, one instance will suffice. Some few years back, not far from Niagara Falls, a man started in the poultry business by buying 25 acres of land and putting thousands of dollars worth of buildings on the place. A couple of years ago, the whole show was offered for about 10 per cent. of what the buildings cost. Within sight of this place, two brothers

started some seven or eight years ago with a borrowed capital of 500 dollars. They have built up a business that yields an annual profit of several thousands dollars.

This brings us to one of the most favourable aspects of the problem of poultry-farming in India. The enterprise can be started with a small capital to begin with, and if the conditions as to climate and locality are ordinarily favourable, profit is bound to accrue. Of course, a great deal will depend upon the attention paid to the undertaking and more especially to small details. It is, perhaps, desirable that a start should be made with a pure breed and that this breed should be studied all the time. This, I may mention, is one of the chief lessons which poultry farming has taught the American breeder. In selecting a locality for the establishment of a poultry farm, it will not suffice to take into consideration only the question of suitable climate and land suited to the successful raising of fowls or ducks or any other descriptions of poultry. If the intention is to supply the market on anything like an ambitious scale, the important factor of cheap and rapid means of communication cannot be left out of account. At the same time, in several parts of India, lands eminently suited to the successful raising of various breeds of utility, poultry are to be found within very convenient distance of Railway lines or *pucca* roads that serve as feeders to these lines.

Poultry-farming in this country is an industry which is certainly well worth the attention of our educated Indian friends, who have moderate capital which they do not well know how to invest, and it is, at the same time, an industry which ought to appeal particularly to Europeans and Eurasians of small means. Of its profitable character, there can be no question whatever, but the profitableness will depend, as in every other industry, to a very large extent, on the character of the man or the woman who desires to embark upon the enterprise.—C. in the CAPITAL.

POULTRY-REARING

Mr. V. Krishna Menon, Veterinary Inspector, Singapore, writes to the MADRAS MAIL :—

Since the publication of my paper on "Duck-Rearing in Singapore," I have received a number of queries from different parts of India by persons interested in the subject.

THE CHINESE MODE OF INCUBATION

There is a general desire to know more about the Chinese

method of incubating eggs but I am afraid it is difficult to impart a knowledge of it to others by correspondence. One cannot learn it without being in a position to receive instruction practically for at least two months. Once learned, however, it is in many respects superior to the use of incubating machines. The necessity of devoting care and attention to the maintenance of a fairly uniform temperature, on which the successful management of an incubating machine depends, is reduced to a minimum in the Chinese method. On the score of cost of incubation again, one will prefer the Chinese method to the use of incubating machines. I use an American incubator, the "Victor," 100 eggs capacity, which I don't think burns more oil than others of the same capacity; but the cost of kerosine oil, in my case, was never less than 3 pies on every duck's egg incubated. There is, besides, a limit to the number of eggs that can be incubated at a time in a machine, whereas the China man does the business on such a large scale that it is not unusual to see as many as 10,000 ducklings hatched out at intervals of 5 days. The appliances employed for the purpose are by no means of a costly nature. A few specially made bamboo baskets, porous sack-cloths, a certain quantity of paddy, paddy-husk and a warming pan being all that is necessary.

This ingenious method is based upon the fact that an egg under incubation develops, as a result of the chemical changes that take place inside the shell, a certain quantity of heat, which varies directly with the number of days the egg has been under incubation. The amount of heat thus developed after the 15th day of incubation amongst, say 100 eggs, if properly preserved, will be sufficient to keep them in a proper state of warmth, and to raise to a certain extent the temperature of other eggs in contact. Hence by skilful arrangement of layers of eggs that have reached different stages of incubation, the whole lot can be maintained at the proper degree of warmth without applying any heat from outside.

Western Incubating Machines

An incubating machine, on the other hand, has its own advantages. A book of instructions is always supplied with the machine One sooner or later will be able to manage it. Moreover, it is not always that one has a large number of eggs to be incubated at a time, and it may not be the intention to introduce fresh eggs for incubation at regular intervals of five days. In these circumstances the use of incubating

machines will be found to be more convenient than the Chinese system. Complaints, however, are not rare that incubating machines have not all the points of excellence claimed. Instructions furnished for their management are, in some cases, open to correction. For instance, 102 to 103 degree is the temperature which is required to be maintained in the egg chamber of an incubating machine, but from my experience both with the machine and the Chinese method, I am led to believe that a successful result can be obtained for duck's eggs by maintaining a temperature of 100 deg. Far. I have repeatedly taken temperatures of ducks' eggs under the Chinese system of incubation, and in no instance could I find them raised above 100 deg. Far. A good deal of annoyance is generally felt in trying to maintain a uniform temperature in the egg chamber of an incubating machine, the contrivances provided in it for the purpose by the manufacturer being not so perfect in their action as to exclude the necessity of close attention on the part of the operator. But experience will teach that eggs can stand more variations of temperature than we at first suppose, and that there is less danger of its falling accidentally below 100 deg., than of the same rising above 103 deg.

What measure of success has attended my efforts at incubating eggs is another point on which information is sought. In this respect, I have not been uniformly fortunate either in the use of machines or in the Chinese system. I have been devoting more attention to ducks' eggs than to fowls', and in no case could I get a more favourable result than 70 per cent., while on two occasions, I lost nearly the whole of my eggs.

THE POULTRY INDUSTRY OF AMERICA

The most Gigantic in the World

From an excellent article on the subject of poultry-farming contributed by Mr. Lewis Wright, the author of "The New Book of Poultry," to the latest edition of the "Encyclopœdia Britannica," we learn that the poultry industry in the United States is the most gigantic in the world, and probably the greatest pecuniary interest the country possesses. By the census of 1900, which tabulates returns from 5,096,252 out of the 5,739,655 farms in the States, the number of fowls over three months old on 1st June 1900 was returned as 233,598,085, with 6,599,367 turkeys, 5,676,863 geese and 4,807,358 ducks, or 250,681,673 birds in

all, valued at 85,794,996 dollars. This, however, would include very few of the chickens raised that year, which would not have reached the age stated, and mainly represents breeding and laying stock, which thus averages about 49 birds to every holding; it also of necessity omits many of the smaller city-lot raisers. The value of the poultry raised during the whole year 1899 is given as 136,891,877 dollars, and of the eggs produced (1,293,819,186 dozen) at 144,286,186 dollars; a total year's product of over £56,000,000. Adding only a very moderate amount for city-lot and other small producers not making returns, it will be seen that the poultry industry in America exceeds in value either the wheat crop, or swine crop, or cotton crop, which probably comes next in value.

EFFECT OF FOOD ON EGGS

The effect of food on the flavor of eggs is found by an English medical man to be surprising. When the hens act as sea-vengers, their eggs are made unfit to eat, but a diet of sunflower seeds produces remarkably fine and sweet eggs.

WOOL AND SHEEP-BREEDING

The total number of sheep in the world is estimated to be 480 million. In Australasia, there are 83 million, whilst the United Kingdom has 30 million. India ranks eighth on the list of wool-producing countries with a total of 18 million sheep or one million below that of France, and the production of wool in India was estimated in 1905 at 85 million pounds. These figures indicate that in the production of the fibre which has been used by man from the very earliest times, India is contributing no small proportion of the world's supply. Whilst there are probably more urgent problems to be dealt with by those interested in the development of the resources of India, it is to be hoped that some practical attempts will be made before long to improve the staple of the wool grown here. Whilst it is unlikely that any marked improvement can be looked for in the wool grown on the plains, there appears to be no reason why sheep raising conducted on a larger scale than has yet been attempted might not be undertaken successfully in the hilly districts. It has been already proved by a series of experiments carried out some years ago, that under better conditions and

careful breeding, the indigenous sheep of India can produce wool of a fair quality, but these experiments need to be made on a much bigger scale.

Bees, Beeswax & Honey

BEE-KEEPING IN INDIA

A Profitable Industry

Mr. V. G. Dhanakoti Raju, of the College of Agriculture, Saidapet, writes:—It may be interesting to describe bee-keeping in India and draw a comparison between this and the methods adopted in Europe and America. Bee-keeping in India is very rarely carried on, especially in the Madras Presidency. In Coorg, bees are domesticated by villagers. The latter take earthen pots with holes pierced in them, besmear the inside of the pot with honey-wax and place them upside down on a piece of wood or a slab of stone. The bees are attracted to the spot by the smell of the wax, and the person intending to domesticate them finds after a few days that they have taken to remain in the pot. He then removes the pot at night, after having covered it over with a blanket, and places it either on a tree near or under the eves of his house or in any adjoining place. The general method of harvesting the honey is rather peculiar. The bees are driven from the comb by a tuft of burning grass placed just under the tree or rock where the bees are hanging, and during this process, no doubt, many of the bees are lost by their wings being singed and burnt to death. After this is done, the whole comb is taken along with the young brood in it. The shop-keepers again adulterate this honey with jaggery-water, just as they do in ghee with safflower oil. This is the so-called honey we get in our bazars.

Such a system of bee-keeping and honey harvesting also prevailed in Europe years ago. The first great improvement was the invention of the frame hive. The improved hive rendered it possible to examine the comb and bees at any time, to feed, to take the brood and stores of honey from one hive to give to another, to change the queen, make artificial swarms and generally to control the breeding and take the stores without injuring the bees. A number of observers have chronicled the life-history and anatomy of the bee, and these are now so far understood that bees can be bred with as much certainty as poultry, fish, etc. The invention of queen cages, smokers, honey extractors, has made bee management easier,

simpler and also more certain in its results. The new system has rendered it practicable to keep bees on a large scale as a remunerative employment.

As to the possibility of keeping bees in India after the improved method, there can be no doubt. The beginner must have at least a frame hive, a queen cage, smoker and the honey extractor. The progress of the bees depends upon the skill of the bee-keeper. The return for the capital spent on this industry, is as certain and relatively much higher than in any other rural industry. Besides that, it is an advantage to keep bees in every garden as they help cross-pollination in plants. I have seen several instances where plants have not produced good seeds although they have beautiful perfect flowers, and this is all due to the absence of bees to fertilise the pollen.

Although there are five or six varieties of bees known only three are important. The *Apis Florea* (*Sirrati Thani* in Tamil) is a small bee that builds a single comb on trees, walls and bushes. The *Apis Indica* (*Thodemtnani* in Tamil) is a bee that builds a number of parallel combs in cavities in trees and rocks, etc. The *Apis Dorsata* (*Kadanthi* in Tamil) is a bee that builds an immense single comb under the bough of a tree or over-hanging rock. The bee-keeper must know which kind of bees can be selected for domestication. The cultivation of *Apis Dorsata* is impracticable, because the one comb cannot be taken without taking the brood with the honey. There can be no doubt that *Apis Indica* may be cultivated successfully. I have tried experiments at Rajapalayam, a place close to a forest in Tinnevelly District, with *Apis Indica*, which proved successful. I managed the bees with a few appliances I have, such, as smoker, queen cages, honey extractor and frames, etc. But, as a matter of fact, the yield of honey from a hive of *Apis Indica* is below the average quantity as obtained from a hive of Italian bees. We might propagate Italian bees in India by introducing a queen bee in a hive of *Apis Indica*. I think good honey should be as readily procurable in the bazars as good ghee, and I am sure the introduction of bee-culture in India would bring about this result.

BEES IN INDIA & AMERICAN INVESTIGATION

Mr. F. Benton, the head of the Agricultural Section of the Bureau of Entomology, U. S. Department of Agriculture, is now touring through India for the purpose of

inquiring into the several species of bees and sending live specimens to America for trial in that country. The large honey bee has always been an object of much interest to bee-keepers, and several attempts have been made to introduce it into European agriculture, but without success. Mr. Benton is not sanguine that improvement can be effected in America by the importation of Indian species, but he considers that there is a considerable opening in India for a bee-keeping industry, both in the hills and in the plains, if simple scientific methods are taught well within the capacity of the Indian peasant. Mr. Benton has just completed a tour through Russia, Asia Minor and Persia and proceeds from India to the Philippines with a similar object. Such tours of investigations are evidence of the thorough methods employed by the U. S., America for the improvements of her industries.

TRADE AND MANUFACTURE OF BEE'S WAX

We rarely see bee-hives in inhabited localities. Bees generally build their hives in places unfrequented by men. Officers of the Forest Department frequently come across bee-hives in large numbers in deep forests. These hives are collected by the people of the forests, who melt them down and sell the wax. In the forests of the Sunderbans, Assam, Nepal, Chota Nagpur and Orissa are to be found millions of hives.

The wax from the hives is at first obtained in a very impure state. Dishonest traders again mix up many fatty substances with it. The wax has therefore to be refined, or it serves no useful purpose. The uneducated people of the forests do the refining in a very simple primitive way. The hive is put in a vessel partially filled with water and heat is applied. The hive melts with heat and the portion of it which is wax, floats like oil, on the water. When the melted hive looks like oil, it is poured out into moulds and wax is formed when the mass cools down. The moulds are next immersed in water and the wax separates from the mould. The wax obtained in this way looks rather yellow. In some places, mustard-oil is used instead of water in the melting process. But the wax obtained in this way do not fetch a good price in the market, as it is very difficult to refine. The wax obtained from villages in the form of various moulds, is again melted in wax factories. A further process of refining is performed, and the wax is now laid out in the form of

bricks. This refined wax goes to England, while the unrefined wax goes to China, Singapore and some other places. India sells very little refined wax, simply because the people do not know how to refine properly. The wax industry has a great future before it, if educated people will take to it and employ improved process of refinement, as they do in China and America.

The refining process is briefly as follows:—The impure wax is cut into very small pieces with a knife and are then boiled in water. The boiling mass when it looks like oil, is slowly poured out into a tub of water, the water being constantly agitated. The melted wax now floats on the surface of the water in small masses. These wax particles are dried in the sun, generally on the roofs of buildings, care being taken to protect them from dust. The particles gradually grow whiter and whiter as they are dried. One to two weeks is sufficient for a thorough drying. The wax obtained in this way is again melted, immersed in water and dried in the sun. Generally after two exposures, the wax is again melted into the form of moulds. On being immersed in water, the wax separates from the moulds. The wax blocks are now stamped with the name of the factory. Great care has to be taken when the work of drying goes on. The wax has frequently to be moved about with a stick. Adulteration in wax, is easily detected by chemical analysis and therefore adulterated wax sells at a low price.

Besides candles, wax-cloth and dolls, many articles are made of wax. In the preparation of polishes and as wads for cartridges, it is largely used. In Government Medical Stores, wax is used in the preparation of ointments. A kind of black-wax is prepared from the sediment which remains in the process of boiling. Goldsmiths prepare moulds for ornaments from this wax. Thus no part of wax is wasted. In America, people lay out large flower-gardens for farming bees. The refining process can be very successfully carried out in India as the sun shines fiercely thoughout the year. Educated Indians may very profitably turn their attention towards this direction. Five to ten thousands Rupees will be quite sufficient for starting on this industry.

If the indolent village-folk will prepare wax in the manner described above, they may earn a considerable amount. Impure wax sells in Calcutta at Rs. 40 to Rs. 45 per maund and wax once refined at Rs. 55 to Rs. 60 per maund. If a man can prepare 5 seers of wax, he may earn Rs. 5.

The gain from honey too is very considerable. A seer of honey sells from 8 annas to Rs. 2 according to quality.

WAX CANDLES

Pure wax candles, *i.e.*, free from tallow, are in great demand on occasions of ceremonial observances by the Hindus all over the country.

A regular industry on a proper scale is bound to be lucrative.

Mill Industry

STARTING OF SMALL MILL

Mr. B. N. Dass, 98 Clive Street, Calcutta, writes:—

'When I suggested the starting of small mills, many people endorsed my view, while others laughed outright at the idea. Many went so far as to assert that, according to expert opinion, small mills can not be worked at all. I, therefore, give below an estimate of the probable expenditure necessary for starting a small mill in this country.

Capital

The following machinery is required :—

A Boiler, 12 N. H. P.	£	100
An Engine, 10 N. H. P. ...	,,	78
1 Pirn-winding machine ...	,,	30
1 Bobbin-winding machine	£	56
1 Warping machine	,,	30
1 Slasher-sizing machine... ...	,,	170
1 Size-mixing apparatus	,,	35
1 Drawing-in frame	,,	5
50 Looms at £12-10 each, ...	,,	625
Shafting and pulley	,,	110
Other parts and accessories ...	,,	170
Total	£	1,409

Taking a £ to be equivalent to Rs. 15, the above will come up to Rs. 21,140. The cost of a shed for the factory will be about Rs. 5,000, and the setting up of machinery, fittings, etc., may cost another Rs. 1000, so the total expenditure will not exceed Rs. 27,000. A working capital of Rs. 3 to 4 thousands is all that is required for the yarns may be purchased at 45 days' credit.

Production

It is said by experienced men, like Mr. Johnson, that each power-loom can produce in India 70 lbs of coarse cloth per week, so the medium cloth may safely be put down at 60lbs. per week. Calculating at this rate a month's production may be put down at 270 lbs. One pair of "dhootie" weighs obout 2lbs, so 135 pairs of dhooties will be the monthly outturn of each loom. Consequently the production of 50 looms will be 6,750 pairs. Even if we leave out of consideration 750 pairs for holidays, etc., still 6000 pairs will be no mean monthly production.

Manufacturing Expenses

1	Manager	Rs.	125
2	Jobbers	,,	70
25	Weavers @ 20 each	,,	500
	Women for winding	,,	50
4	Men for warping and sizing	,,	85
2	Boys for drawing-in	,,	20
4	Coolies	,,	35
2	Men for folding room	,,	30
2	Clerks	,,	35
4	Chowkidars	,,	40
1	Engineer	,,	30
1	Fireman	,,	15
1	Cleaner	,,	15
1	Oiler	,,	15
	Coal for boiler	,,	150
	Oils and petty stores	,,	100
	Rents, taxes, etc	,,	100
		Total Rs	1,415

The above estimate is made on a rather extensive scale and the actual expenditure may come down to a much smaller sum than stated above.

If Rs. 1,415 be put down as the manufacturing expenses for 6,000 pairs of dhooties, the expenses per pair comes to about 3 annas and 9 pies.

Profit

It is difficult to say what the exact profit would be, but the following estimate, is based on the present price of yarns and cloth in the market, may be taken as fairly accurate. If the prices of yarns rises, the prices of cloths will also rise proportionately.

In a pair of dhootie, 44 inches wide and 10 yards long, of which the warp is of 40's yarn, 64 threads per inch, and the weft of 50's yarn, 60 threads per inch, the yarn required would be about 34 hanks of 40's yarn and 34 hanks of 50's yarn, inclusive of wastage. At the present rate of $10\frac{1}{2}$ annas per lb. of 40's and 11 annas per lb. of 50's yarn, the price for the 64 hanks amounts to about Re. 1, and, if coloured borders are required, the price would be one anna more, so the price of yarns for such a pair of cloth is Re. 1-1. About half pound of size need be added to the yarns, thus the cost of size will be 1 anna and the cost of manufacturing as shown above will be 3 annas 9 pies, so the total cost for a pair of cloth amounts to Re. 1-5-9. The present market price for such a pair of imported dhootie is at least Re. 1-9-0 so a profit of at least 3 annas per pair may safely be expected. Calculating at this rate, the profit for 6,000 pairs will be Rs. 1,125, *i.e.* per month. Setting apart from this sum a portion for repair of machinery, insurance, brokerage, expenses of sale, etc., a nett profit of 700 to 800 rupees may be expected every month.

From the above will be seen what can be done with small weaving mills, without which it would be impossible for us to compete with foreign goods, and unless we can produce cloths of the same price as imported ones, which we can only do with

power-looms the Swadeshi movement cannot last long. With larger mills, a better profit may be made, but as it is not possible, at the present time, to find sufficient capital for such big mills, at least in Bengal, I advocate the starting of small factories on the lines suggested above, in the hope that at least a few of our monied men will come forward to give the scheme a trial, and, I am confident, they will succeed, while their success will open the eyes of others to follow in their wake, and then, in about two years' time, we may expect 50 or 60 small mills in Bengal, meeting at least a portion of Bengal's requirements.

JUTE MILL IN BENGAL

Of the several manufactories the jute mills are the most important and occupy a very conspicuous position amongst the various industries of Calcutta. All the mills, without a single exception, are managed by European firms under European superintendence and not a few of them entirely with European capital. Jute industry being a monopoly of Bengal, all the mills are thriving well and all of them are paying good dividents.

There are altogether about 34 Jute Mills in Calcutta, situated in various part of the Suburbs of Calcutta, on both sides of the river Hooghly, eastern bank or the right bank of the river occupying the largest number. A few are situated far from the river, but having communication with the river by the Balliaghatta canal. The first and the most ancient jute mill started in Calcutta is the Baranagore Jute Factory managed by Messrs. George Handerson & Co. The unprecedented success of this pioneer mill made many European firms of Calcutta start jute mills and as the demand is steadily increasing every year, all the mills are fully employed and there is ample room for a few others. The only progressive trade in Bengal is the jute-trade and other trades having intimate connection with jute. With a capital of about 20 to 30 lakhs of rupees, a good jute-mill may be started, and if managed economically and wisely, it may yield a very good divident.

We can suggest to our countrymen to start a joint-stock enterprise in this direction and there is every chance of its being crowned with success. Before the days of the jute-mills, we had in our country a kind of gunny bags, known as country-gunny, which used to be imported into Calcutta from the northern districts of Bengal, which were very strong—much stronger than the mill-gunnies now in use, but were a

little rough-looking. Large quantities of this kind of gunny used to be exported to Europe and America and fetched very high prices. This hand-made or rather country-gunny industry is nearly gone and whatever little is still left of it, is completely lifeless and may in a few years completely die out. If the weavers of the country-gunny are only made to make their gunnies like the mill-gunnies (woven with thinner thread) of different thickness in immitation of the mill-made gunnies with blue and red stripes, there may be still some chance for the trade. But, this trade completely left in the hands of the ignorant weavers and without any assistance from Government or intelligent people, is bound to die a natural death in a few years.

BENGAL JUTE MILLS AND GERMAN COMPETITION

Dundee was the first to start Jute mills for the purpose of manufacturing gunnies and was in the full enjoyment of the monopoly for many years. Calcutta mills were then started which successfully competed with Dundee in all the foreign markets. But as nearly all the Calcutta mills had been started with the capitals of the Dundee mill-owners, they were not at al material losers in any way by the Calcutta mills. But now both Dundee and Calcutta, have found formidable competitors in Germany, where several Jute mills have recently been started under State patronage and protection. It will be no wonder, if like German sugar and other articles, the Calcutta market is flooded with bags "made in Germany.," ere long.

ADULTERATION OF JUTE

With a view to increase the weight of Jute, middleman generally put water in it. This fraudulent practice does not only cheat the honest buyers, but also serves to decrease the strength of the fibre and destroy the gloss and colour of it. This moisture is also the direct cause of many unfortunate fires that take place every year at Calcutta. The Government are contemplating to take steps to stop such malpractices by legislation.

FLOUR AND OIL MILLS

Of the several other manufacturing industries carried on with the help of machinery, flour and oil mills occupy a very

conspicuous position. In Flour mills, the old style of grinding wheat with stone *chakies* or round stone grinders is getting out of fashion and is being completely done away with. In the place of the old stone *chakies*, steel rollers are now in use which grind wheat much better and far quicker.

In Calcutta, there are two big and well-organised Flour Mills conducted by two first-class European Houses with success. There are also many other equally first-class Roller Flour Mills conducted by the Bengalees with equal success. But this industry seems to be overdone and there is not much room left for any more big mills.

Lately, however, a kind of small mill has been imported here from America which is cheap and can be conducted with very small capital and grinds about 30 mds., of wheat in 12 hours. The cost of this kind of mills including an Oil Engine of about two horse power can be had for about Rs. 1,500 to Rs. 2,000. Such small mills are very suitable for Muffissil towns, where they can be started with great profit, specially if they are situated on any Railway line, insuring cheap and speedy import of wheat from the Upper Provinces.

Mustard Oil Mill comes next and occupies a far more important position and is at present a very profitable industry in Calcutta. About 5 or 6 years ago, all the Oil Mills of Calcutta used to act independently and to produce or sell oil as it pleased the proprietors. They naturally were also obliged to sell their oil in competition with other mills and hence this industry often used to lead the proprietors to loss and ruin. But the proprietors of several Oil Mills found out their mistake and they made a combination amongst themselves, binding themselves to sell their oil at certain rates to be fixed by the Committee every week and to stop their mills when there was any accumulation of stock or when the demand did not exist. Thus, all the Oil Mills are making profit and all of them are thriving. At present, this industry is one of the best and surest industries in Calcutta. A small sized-mill with about 100 crushers (*Ghanies* as they are commonly called in Bengal) can be started with a capital of about Rs. 20,000, and is sure to yield a handsome profit equal to about 50 per cent. of the net outlay. We recommend this trade to any one who has at command a sufficient capital to start a mill as aforesaid. Of all the known trades, this oil mill business is the safest now, on account of the existence of this unity amongst the different mill-

owners. That unity is strength, is amply verified in this trade and every one of the members of the Committee is enjoying a perfect security against loss, so far as the rates and stock are concerned and there cannot but be uniform and steady profit in the business, unless it is very badly managed or the management be in the hands of thieves. If the members of the different trades of Calcutta thus unite themselves into Committees to protect their own interests like the one just referred to, it may be that each and all of them may fairly prosper and the chance of losses may be reduced to minimum.

There is another kind of oil manufactured at Calcutta and is largely shipped to different parts of the world. This is Castor Oil and is obtained from castor seeds. There are two different ways of getting this kind of oil out of castor seeds—(1) crushing the seeds by Hydraulic power and (2) by the driving of a kind of screw by hand-power. Of these two means, the latter is very largely resorted to and is considered to be the better of the two, in as much as, it has been found that, the latter contrivance yields more oil and at the same time is less expensive. This machine consists of a long screw with a wheel attached to one of its ends and the other end touches an iron plate placed at the end of a long narrow passage where castor seeds are placed filled in bags, made of strong gunny or canvas, in rows—having iron-plates of the same size as the bags placed between each two such bags, containing husked castor-seeds. The bags are generally about one foot long by about 6 to 8 inches broad. There is a fire-place running along the whole passage, where sufficient fire is kept up, to impart sufficient heat to the seeds to make them a bit softer and easily to yield oil. Then the screw at the end is gradually driven home by hand-power, which pressing against the iron plate at the end of the bags, gradually squeezes the bags into smaller and smaller size and the oil comes out. This is a very crude method, but is suppposed to be the best and better than the Hydraulic power. This oil then is placed in the open, and sun and dews help to cleanse it of the impurities which settle down and the oil becomes purer. There are three kinds of oil generally used for mercantile purposes—No. 1, being very pure and used for medicinal purposes, No. 2 and No. 3 for oiling the machines, wheels of carriages and for other purposes as lubricating oil. When oil has been fully extracted the remnant of the seeds are taken out of the bags, which are known as castor-cakes,

and are very largely used for manuring potato and sugar-cane fields, Tea gardens, &c.

Aluminium

THE SPREAD OF A HITHERTO MINERAL CURIOSITY

Mr. Charles M. Hall's Invention

Aluminium is one of the lightest and brightest of metals, and its great power of resisting corrosion and other remarkable properties have led to considerable anticipations regarding its usefulness, which have been abundantly realised. It is an easily workable metal and can be worked into almost any form which metals such as copper, brass and silver are capable of assuming. These properties were known many years ago, but, while it was made only on a small scale by elaborate and expensive methods, it was regarded as a mineral curiosity, and only within recent years has its cost of manufacture been reduced to enable it to compete with other commercial metals.

It is exactly fifty years ago, when aluminium was sold at £18 per pound. This was prepared in a state of purity by H. St. Clair Deville, who isolated it by electrolysis with ordinary batteries, as at that time no dynamos were available for that purpose. Various improvements were effected in the manufacture which lowered the price to £2-8 in 1886. In 1887, the present method of producing Aluminium was invented by an American, Mr. Charles M. Hall, and was made a commercial success first in America, where a large company was established, and, utilising a considerable portion of the power of the Niagara Falls in the industry, reduced the price to 1s. 6d. per pound. It was subsequently manufactured in England and on the Continent, and at a rate which soon occasioned a most extensive use of aluminium utensils.

A special department was started at the School of Arts, Madras, in April 1898, with the object of introducing the working up of aluminium as a new industry in this country. The brass and copper smiths of the Madras Presidency are excellent workmen, and they found little difficulty in adapting themselves to working the new metal. A market was soon found for their productions, and the European and native population have displayed a marked appreciation of the advantages of aluminium, and are convinced of its superiority to brass and copper for their

domestic utensils. Mr. Chatterton, who nursed the scheme from its commencement, showed that in 1903, or in five years, the amount of business done had increased 5½ times; 426,000 lbs. of metal had been imported from England, and the prices charged for aluminium vessels had decreased by fully 33 per cent. The Department in the School of Art, after this successful experimental career, was closed as a Government concern, and was taken over, on favourable terms, by the Indian Aluminium Company.

Next to creating a market for aluminium in India, is the establishment of works for the manufacture of the metal in the country. For the proper consideration of this subject, it is necessary to know where raw material is available and the probable cost of manufacture on a commercial scale. Aluminium is made in Europe and America from deposits known as *bauxite*. This is a mineral consisting principally of *alumina* or *aluminium oxide* with smaller portions of iron, silica, titania and lime, as impurities. In the preliminary manufacture, the ore is converted into pure oxide by such processes as extraction by sulphuric acid, heating with carbonate of soda, or digestion with caustic soda. For the manufacture of the metal from the oxide, electric power works are necessary, and although we have nothing approaching the Niagara Falls in this country, we have a reserve of energy which can be converted into electricity at a cost probably as low as water-power.

It has been demonstrated by Dr. Warth and Mr. Holland of the Geological Survey that the deposits of *laterite* which cover considerable areas in the Peninsula and Burma have a composition identical with that of *bauxite*, the chief aluminous mineral of other parts of the world. French *bauxites* show a percentage of *alumina* varying from 30·3 to 76·9, and those from Alabama from 39·4 to 62. Compared with these results, the analysis of *laterite*, or as it might be termed, the *Indian bauxite*, from the Central Provinces and Central India afford from 51·6 to 67·8 per cent. of *alumina*, and samples from Bengal and Bombay give from 43·8 to 64·6 per cent. Specimens from the Madras Presidency have been examined, but their average composition does not indicate the richness in *alumina* as represented by the analysis of the more northern deposits. At any rate, one important fact has been proved, and that is that a mineral, which was commonly been employed for metalling roads, has been found to be a source of one of the most useful metals and its deposits in

certain parts of the country will require to be placed under State protection. Under existing circumstances of a limited market and modern factories situated at such long distances away, it is practically certain that no *Indian bauxite* will be found in sufficient quantity and purity to cover the cost of exportation to existing markets. The prices quoted in New York last year varied between 21 and 22 shillings per ton of first grade qualities, and the world's increasing production is at present met by supplies from France, the United States and the United Kingdon .

The future prospects of the aluminium industry in India depend upon the efforts made to manufacture the metal from indigenous sources in this country. About four years ago, a limited liability company called the Cauvery Reduction Syndicate was proposed in London. The object in view was to exploit a project for manufacturing aluminium in Mysore by the use of electricity to be supplied from the Cauvery Falls at Sivasamundram, a great saving would thereby be effected in the cost of the raw material for local manufacture. Whether the Syndicate have actually commenced operations, we are not informed, but it cannot be long before the manufacture is undertaken in earnest. Mysore as a locality for a factory, perhaps, is not so suitable as in the Central Provinces, where the deposits are of greater purity and value. It is reported that more than one firm is engaged in mining operations and that the manufacture of the metal on the spot is soon to be inaugurated. There are difficulties in the way of making both the pure oxide and the metal, where the cost of the necessary chemicals is at present so high, but with expert supervision and the sale of the by-products, which are of great use, the ultimate success of such an undertaking cannot be much longer delayed.

The output of the aluminium factories of the world, is said to be 5,000 tons, while that of copper, the metal with which it can compete most advantageously, is more than half a million tons. Added to this, the growing demand for the new metal for purifying iron and steel, for military equipment and for domestic and technical appliances, besides the use of its salts in medicine and the arts, every effort should be made in this country to perfect its manufacture and reduce its cost.

—Capital

THE PRODUCTION OF ALUMINIUM

Since 1889 the production of aluminium has increased largely. In that year, the total output was only 85 tons, in 1905 it was roughly 8,000 tons. As the production has increased, the price has fallen. From 10s. 6*d.* per pound it has dwindled to ls. 3*d.*, and if a cheaper raw material than refined *alumina* could be used, further reduction in price would be possible. There are at the present time, nine works operating either the Hall or the Heroult methods of aluminium production, and between 40,000 and 50,000 horse-power are employed in the industry. Of these works, only one is in the United Kingdom. Three are in America, two in France, one each in Germany, Switzerland, and Austria. A work is in course of erection in the valley of Pescara, Italy. The demand for the metal is growing in connection with motor-car and railway carriage work, the latest example of its use being for the inside of cars for one of the London under-ground tube lines. The cheaper brands are now being employed in the casting of iron and steel. An invention has recently been patented in the United States for refining aluminium by electrolysis. This depends upon the use of an impure alloy of the light metal as *anode* in a bath of molten *cryolite* containing *alumina* in solution, while pure aluminium forms the *cathode*. All the materials in this bath are kept in the molten state, and the three components are maintained in their respective positions by their different specific gravities, the impure alloy being the heaviest and the pure aluminium the lightest of the constituents of the bath. Aluminium can be parted from iron, silicon, copper, and other impurities by this method, and it may possibly prove of great use in cheapening the production of the metal, since it will enable producers to use *bauxite* directly in the reducing baths in the place of the much more costly refined alumina. By the present methods of production, using refined *alumina* in the reducing baths, it is improbable that any great reduction in price can occur, and therefore the advent of new methods of dealing with *bauxite* to enable it to be used in place of *alumina* are of considerable importance.

CONDENSED MILK BUSINESS

To The Editor

Sir,—We are paying thousands and thousands of Rupees to foreigners for condensed milk to

the detriment of our interest and health. We neither care to know whether such foreign condensed milk is congenial to our health, nor do we care to know its properties. From long experience, it has been proved that foreign condensed milk is the cause of constipation, dyspepsia, and worms in the intestines in many instances.

By a well experimented scientific process, pure cow's milk can be preserved in a condensed or liquid state for any length of time. The milk thus preserved will have rather a salutary effect upon the consumer.

A very profitable business can be carried on in condensed milk. I give you a brief account of probable expenditure and income of a small condensed milk factory.

Let us take, 25 mds. of milk, for daily manufacture, for which we require the following :—

Expenses

I. Permanent Stock

	Rs.	As.	P.
5 Iron Pans, made according to scientific requirements	100	0	0
1 Tank for Raw Milk	25	0	0
Lactometer, Thermometer and other scientific instruments	50	0	0
5 Hearths	25	0	0
Total cost of requisites	200	0	0

II. Daily Expenditure

	Rs.	As.	P.
5 Operators	1	9	0
1 Clerk	0	8	0
1 Cook	0	4	0
1 Servant	0	3	0
Fooding of the Staff	1	0	0
House Rent	0		0
Postage and Travelling	1	0	0
Rs.	5	0	0
Cost of 25 mds. of milk @ Rs. 2/8 per md.	62	8	0
Coal	1	0	0
Ingredients for manufacture	25	0	0
25 mds. Raw milk together with the ingredients will yield 1,000 lbs. condensed milk, for which 1,000 tin-pots, @ 3 per cent.	30	0	0
Hermetically Sealing process	2	8	0
Total Daily Expenditure Rs.	126	0	0

Income

If the 1,000 lbs. of condensed milk were sold at about half the price of the foreign import, *viz.*, at annas 3 per tin against annas 5 per tin sold by foreigners, we shall get Rs. 187-8-0.

Thus, the balance or daily profit comes up to about Rs. 61-8-0.

At this rate, the monthly profit amounts to Rs. 1,845, and the yearly profit to Rs. 22,140.

To carry on a business like this, it requires a capital of not more than Rs. 5,000. Making all possible allowances for competition and fluctuation of the price of raw materials, etc., we can still safely calculate a cent. per cent. profit.

Should any one be willing to start the proposed milk business, I shall be glad to help him to make the business a success. The following preparations of milk can

be preserved and supplied to the Calcutta market :—

1. *Dela Kshir* (খোয়া ক্ষীর) ।
2. Condensed Milk.
3. Liquid *Kshir* (ক্ষীর) ।
4. Butter.
5. *Chhana* (ছানা) ।
6. Cheese.
7. *Sharvaja* (সরভাজা) ।
8. *Ghee.*
9. *Dahi* in a condensed state.

The proposed milk business does not require the whole capital at once or at the very commencement. The first outlay of Rs. 50 for implements and Rs. 200 in cash as working capital might suffice.

ONE OF INDEPENDENT PROFESSION.
96, Beltala Road, Kalighat,
Calcutta.

Cocoanut

ITS OIL AND INDUSTRY*

This industry is chiefly carried on in Cochin, a Native State on the Malabar Coast of India, of all sorts of Cocoanut oil in the market. Cochin oil has the highest reputation.

In Cochin, cocoanuts are taken down from the trees, when the outer part of the fruit just begins to lose its greenish appearance, that is, as soon as the fruit is mature. The fruit is not allowed to become brown on the tree, as in that case, it becomes difficult to extract the fibre, which is also a profitable product of the cocoanut industry.

The cocoanuts are then separated from the fibrous outer covering by means of a pointed stick buried in the ground. The fruits, thus separated, are broken into two. The water is allowed to run off, as, no use has yet been discovered for it on any large scale. The broken shells with the fruit attached, are now exposed to the sun to get dry. When partly dried, the fruit begins to contract and separate itself from the shell. The process is accelarated by entirely separating them with the help of a small pointed stick.

The separated fruit is now thoroughly dried in the sun. When thoroughly dry, they can be safely kept for some time without fear of decomposition. But if they are only partly dried, then the stored article, first becomes greenish in appearance, and then gradually gets rotten. The dried article is generally known as *Copra* in the trade.

When thoroughly dried, the *Copra* is crushed in mills, the result being cocoanut oil and oil-cake. For breaking up the *Copra* and crushing it, there are various methods. The simplest is the

* For Cocoanut Palm in Travancore. *vide* p. 98 *ante*.

ordinary country oil-mill or *Ghani*, as we call it in Bengal, driven by bullocks. Oil-mills of all sizes can also be used for crushing the *Copra*. Almost the whole of the cocoanut oil industry in Cochin is in the hands of the Bombay merchants. The three largest oil-mills in Cochin belong to, (*a*) Messrs. Abdas Satar Haji Moosa, (*b*) Ranchordas Ketry, and (*c*) Alibhoy Kadirbhoy. all of Bombay. These are big mills. But there are many small mills also. In fact, where the bullock powers is still used for extracting oil, any steam engine, however small, may be used with profit. But in all factories, the larger the steam engine, the more economical is the consumption of fuel, etc.

I think, in Bengal, we have not got a sufficient supply of cocoanuts to start the oil industry. Unless cultivation is largely extended in the Sunderbuns, I do not think there will ever be a sufficient supply. The Sunderbun, I believe, is an ideal place for growing cocoanut trees. The cultivation is easy. No expensive *bunds* or embankments are necessary to keep off the salt water as in rice cultivation. In Cochin, miles and miles of the backwater are being regularly reclaimed by extending the cocoanut plantations right into the water. Narrow *bunds* are made with a foundation of stone, etc., from neighbouring hills with about one foot of soft mud on top. During high tide, the water reaches almost up to the top of these narrow *bunds*. Cocoanut trees, planted on the tops of these *bunds*, would thrive best. These *bunds* are not water-tight and in fact, often extend into the water from the adjoining dry land.

The husk of the cocoanut is steeped in salt water, somewhat in the fashion of jute plants. But the cocoanut husk has to be kept under water for about six months before it is practicable to beat clean fibre out of it.

The shells are used as fuel. The leaves of the tree are used for thatching bungalows. The dead trees are used as timber in making jetties, etc., in salt water, where they last much longer than could be expected from their soft interior.

Any one who wishes to take up this industry should go to Cochin. The journey is easy now, since Ernaculam, the capital of Cochin State, is now connected with Shoranur on the Madras Railway by a metre gauge Railway, constructed by the Cochin Durbar.

COCOTINE—A SUBSTITUTE FOR *GHEE*

Mr. Hara Śanker Roy writes in the Market Report :—

"After a long period of experiment, a French Scientist has succeeded in getting a new preparation from cocoanut, *viz.*, cocotine. It is nothing but highly purified cocoanut oil, in edible form. Lately, I had an occasion of trying cocotine ; the following is my experience :—

"Cocotine is a perfectly colourless oil with a slight smell of cocoanut. I had *Luchis* and *Kochoories* prepared with it, and I found them excellent and hardly distinguishable from things prepared with *ghee*. For dyspeptic people, articles of food prepared with cocotine is preferable to those made of *ghee*, because it is less heavy and does not produce the burning sensation due to acidity. Undoubtedly, this would prove a boon to people with weak stomach with whom *ghee* does not agree. The only defect of cocotine is that, if eaten raw with rice, it smells like cocoanut oil.

"I would highly recommend cocotine to native sweetmeat manufacturers, they can do nothing better than substituting it for bad *ghee* which they generally use. Cocotine is twelve annas abominable. The European pastry cooks should also use cocotine instead of lard, as the superiority of a pure vegetable oil over an animal fat, however purified, is undeniable.

"The cocotine which has been put into Calcutta market by Messrs. Jambon & Co., is the production of a Pondichery manufactory, the process of manufacture is kept a profound secret, but if local chemists, like Dr. P. C. Roy, try independently, a method would be easily found and I hope local capitalists would not be wanting to start business in this line."

MILK FROM COCOANUTS

Mr. D. Pillai writes to the "Madras Mail" :—With reference to the query, as to whether there is any small machine or other contrivance for the purpose of extracting milk from cocoanuts, I beg to say that although, so far as I am aware there is no machine specially designed for that purpose, I think what is known as Tincture Press, may with advantage be employed in this case as well, as this simple apparatus, which is a compact screw press, is used by the chemists for squeezing out and recovering the last

succulent substance. I have tried it myself for taking out the milk of cocoanuts, and I have found it very useful, having the advantages of being both speedy and effective in its operation.

VEGETABLE BUTTERS FOR FOOD REFORMERS

London: May, 1906. —Some dainty looking dishes were set before the members of the London Vegetarian Society the other day, in a food exhibition, which was the feature of their reception at the Memorial Hall, Farringdon Street. The cow, as a butter-producing animal has now been entirely superseded, so far as vegetarians are concerned, and by the following curiously-named vegetable fats made from nuts :—

"Nutter."	"Albene."
"Nucoline."	"Cocolardo."
"Nuttene."	"Vejsu."

These are mostly portmanteau words. For example, "nutter" expresses nut butter very neatly; "cocolardo" is equally adequate for "cocoanut lard," and "vejsu" represents "vegetable suet." Walnut sausage meat is also available for vegetarians, and may prove the final inducement to a hesitating flesh-eater on the brink of con-[illegible]

Winifred Godhold, has just started at the Memorial Hall six ladies and one plucky ma[illegible] already enrolled as pupils, th[illegible] some vegetarians are agitati[illegible] a class for "men only." [illegible] cake made with "nutter" [illegible] a representative of the "[illegible] Mail" and found to be quite [illegible]cious. One of the most inge[illegible] substitutes is that for gel[illegible] such as used for jellies. It [illegible]tained from a West Indian [illegible] weed known as "*agar-agar*." [illegible] jellies exhibited were most ap[illegible]ing in appearance, and we[illegible] translucent as stained-glass [illegible]dows. The hen appears to b[illegible] only living vertebrate tha[illegible] vegetarians have not disp[illegible] with, and eggs still loom large in their menus.

THE BETEL-NUT INDUS[illegible]

Betel leaves are a fav[illegible] article of daily consumption [illegible] us —Indians. The betelnut [illegible]fore is an indispensable ite[illegible] most households and thou[illegible] grows in abundance all [illegible] the country, so great is the de[illegible] that a very large quantity [illegible] is imported annually into In[illegible]

Last year, 7 lac maunds [illegible] valued at Rs. 24,00,000 [illegible]

countries from India, but still there remained a deficit of some 2 lacs of maunds for our own requirements, causing a consequent drain of some lacs of rupees out of the country, which, could be stopped altogether or at least substantially minimised by paying greater heed to production.

Then, it is not perhaps, generally known that portions of the bark of the tree, which act as cover to the nut bunches, when in flower, serve as excellent wrappers for cigarettes. They are much cheaper, while stronger, than the thin paper covers now used. Their value is gradually coming to be known and for the past few years, a growing-trade in betel-nut wrappers is being carried on between Burma and some Districts of the Chittagong Division, pre-eminently, Noakhali.

PRINTER'S BUSINESS— A GOOD LINE IN LIFE

The number of Printing Presses is daily increasing in our country. But there has been no proportional improvement in printing or in this management of Presses. This is due to the fact, that only uneducated people or men with little knowledge of reading and writing, become printers here; whereas, in Europe and America, educated men have taken to the business of printing—and by their intelligence and application have greatly improved the printing business.

In connection with this, the Book-binding business also needs much improvement. In Calcutta, this business is a monopoly of the Mahomedans only. If men of culture and taste start Binding factories, they are sure to be profitable. Publishers of books have often to suffer great trouble, and somctimes loss, for want of good binders with a real sense of responsibility.

In Europe and America, Press business is regularly taught. In many Technical schools, there are separate classes for this. Then, there are also schools where only Printing business is taught. In London there are two institutions, in one of which type-printing and in the other Lithograph-printing is taught. Their names are—St. Bride Institute Printing School, and Bolt Court Lithographic and Process School. In Brussels there is one, named 'Trade School of Printing'; in Paris there are two 'Estienue School' and 'Guttenburg School'; in Berlin there is one, 'School for Printers' Apprentices," in Milan there is one School of Printing.

We give below an acconnt of the mode of instruction imparted in the 'Estienue School' of Paris,

which is considered to be one of the best of its kind.

The school was started in 1889, and a small building was hired for it. In 1896, a big mansion was built for the Institution, which together with the adjoining lands cost the authorities about ten lacs of rupees. Students desirous of entering the school, have to pass a preliminary examination on Dictation, Arithmetic and Drawing from plaster models. Students must not be above 16 and below 13 years of age. For the first four months, students have to be instructed in all the classes, after which a student is entered into any one special department for which he has shown greater aptitude.

Two kinds of instructions are given—general and practical. They are taught French, History and Geography, Elementary Mathematics, including Geometry, Physics, History of the Printing Press, Painting, Clay-Modelling, Gymnastics and Military Drill. According to the particular efficiency of students, they are also taught Engraving, Lithography, Gilding, Compositor's business, Stereo, Photo-engraving, Book-binding, &c.

It is needless to say that young-men coming out from such an Institution can manage all the Departments of the Printing business very satisfactorily.

Essential Oils

MR. GEORGE BROWN'S INVENTION OF EXPRESSING

It will be welcome news to many that Mr. George Brown of the Talawakele firm, has invented a machine for perfecting the method of expressing essential oils from odorous leaves, flowers, roots, and stems of plants, such as champao oil, lemon-grass oil, citronella oil sandal-wood oil, &c. The machine consists of an arrangement of pipes, troughs, strainers, syphons, &c. The whole apparatus can be placed within a small area, is easily controlled and does not need any skilled labour. The condensation process does not need the vicinity of a river or stream. Its detailed claims cover considerable improvements in appliances of its character. The net result of the improvements is a remarkable saving of time labour, and expense, without any need of skilled workmen, and it renders the user of the machine independent of local conditions, leaving him free to work in districts where there are neither rivers nor large tracts of water, while it protects the finished product from discolouration, as the whole apparatus is made not of copper, but of pewter, galvanized iron,

or some other equally suitable material.

OIL-DISTILLING IN SOUTHERN INDIA

The Government Gardens in the Nilgiris, Ootacamond, have established an oil distilling industry, the existence of which is probably not known on this side of the country. The oils being worked there, are :—Oils distilled from different varieties of "Eucalyptus; Camphor Oil from "*Cinnamomum Camphura*; Gaultheria Oil from "*Galtheria Fragrantissima*"; Wild Cinnamon Oil from "*Cinnamomum Wiyhtu*"; Litsea Oil from "*Litsea Zeyhanica*"; Sweet Flag Oil from "*Acorns Calamus*"; and Lemon Grass Oil from species of "*Andropagan*" grass. These oils are the products of local indigenous plants or those cultivated in the gardens and most of them are stocked for public sale.

ESTIMATE OF WORKING AN ESSENTIAL OIL FACTORY

(a) Grass Oils

Rhusa, Khus, Khavi, Nimbughas and various other species of fragrant grass grow wild in the Punjab, showing the possibility of their cultivation. In many tracts, the farmers are uprooting these valuable materials of great economic value. Here I may point out that, in Singapore, there are some hundreds of acres put under cintronella and lemon grass by the famous Pisher Co. In the Punjab, these grasses should be cultivated anew, and the supply, that is available now, we should commence to utilise.

We find that *patchouly* can also be cultivated in the Punjab. Its seeds or plants are available at Singapore.

The following is a general estimate for a factory,

	Rs.
Plant, costing	10,000
Buildings	5,000
Appliances	2,000
Running capital	33,000
Total Rs.	50,000

(b) Citronella

	Rs.
Raw materials for one month—840 mds. Costs at 12 annas per md. on the still	630
Fuel and other expenses	150
Establishment	500
Interest	210
Wear and tear	80
Permanent expenses	940

One still with lemon grass yields out 1,260 lbs. of Citronella Oil.

The other still with lemon grass yields 1,260 lbs. of lemon grass oil.

	Rs.
Citronella costs	630
Lemon grass, 840 mds., at Re. 1 per md.	840
Common expenses...	940
Total cost ..	2,410

INCOME

	Rs.
Citronella oil at Rs. 1 0 0 a lb. .	1,260
Lemon grass oil at Rs. 2 0 0 a lb. .	2,520
Total sale. .	3,780
Deduct expenses	2,410
Net profit, per month	1,370

(c) Anise Oil and Thymol

These are others that I have experimented upon. The following are the figures :—

Anise for one still per month, 840 mds.

	Rs.
Costs at Rs. 5 a maund on the still ...	4,200
Ajowayan for the other still 840 mds., costing Rs. 4 per maund ...	3,360
Common expenses	940
Total costs	8,500

Yield of oils—

1,260 lbs. Anise
300 lbs. Thymol. Crystal
1,700 lbs. Ajowayan Oil

Total—3,260 lbs.

	Rs.
Anise oil at Rs. 5 a lb.	6,300
Thymol at Rs. 8 a lb.	2,400
Ajowayan Oil at Rs. 2 a lb.... ...	3,400
Total sales.	12,100
Deduct expenses	8,500
Net profit per month ..	3,600

As for the consumption, an organisation is needed to distribute the products in India. Some of the oils can be exported.

(d) Camphor

India is a camphor-buying country. It is obtained from camphor trees. It grows abundantly in Formosa, China and Japan. There are some suitable climatic conditions for the plantation of camphor trees in India. But the competetion which Japan is opening with the world in this industry, renders the chances of this industry being hardly profitable in India. Some interesting papers on the cultivation of camphor, printed later on, will be read with interest.

(e) Lemon Oil

This oil is usually and commercially extracted from the rind of the citrus species and not particularly the lemon peel. One from the lemon peel is very dear. For this oil, there are plantations of lemon in Italy. There is a great field for such a plantation of India.

Lemon juice serving as a raw material for citric acid and the lemon peel for oil, the plantation of lemon would be a great industry in itself. Our people should stir themselves and see if there are tracts of land available for such an experiment.

No definite estimate can be given for evident reasons. But, considering the consumption of this oil and its general demand in all countries, the industry promise to be paying, like all other essential oils. (Reproduced

from a paper read at the Benares Industrial Conference of 1905 by Mr. Puran Chand, Analytical Chemist (Tokio) in charge of the V. D. H. J., Technical Institute, Lahore).

(f) Eucalyptus Oil

There is again a great field for manufacturing Carraway-seed and Eucalyptus Oil in India.

A large Limited Liability Company with an exploiting capital will open a great prospect in India of Essential Oils. While prospecting, the Company can utilise its capital in manufacturing best Indian perfumes on a large scale by the adoption of Western Scientific Methods. There is a great margin of profit in *Atters* of Rose, *Kewra*, *Khas-Khas*, *Bela*, *Chameli*, etc. The different seasons, as they appear, will, in rotation, supply the factory with materials to work upon and thus keep it engaged throughout the year.

Cotton-Seed

Its Oil in Common Use and Oil Cakes as Fodder

Seeds of cotton are treated as mere refuse in this country, while in other countries, they form an important article of commerce. In America, Cotton-Seed Oil is a thing in common use. The seeds themselves also are a good food for cattle which are used as such in some districts of Behar in the same way as oil-cakes are used in Bengal.

A mercantile firm in Calcutta, is going to import machinery from England for expressing oil from these seeds.

In Central Provinces, too, which is a great home of the cotton crop, machinery are soon, so it is reported, to be set up for extraction of oil.

Cotton-Seed Meal as a Famine Food

It was a poor Yankee, we believe, who discovered the value of cotton-seed oil, which is now one of the most important and lucrative industries in the United States of America. Before that discovery, cotton-seed was a waste product, and cotton-ginning mills used to be hampered with it, not knowing how to dispose of the "waste." In 1867, there were only four mills in the States for manufacture of this oil: to-day there are over 500 mills. In this country, we are only just awakening to the fact that there are other uses for cotton-seed, besides feeding it whole to cattle and burning it in *Chirags* on occasions such

as the *Devali* festival. The uses to which cotton-seed oil has been put are various. Some 13 years ago, when hogs were scarce in America and lard was dear, fully half the quantity of oil extracted from cotton-seed was used as lard substitutes. The American make of cotton-seed oil, goes into a variety of commodities, comprising compound lard, margarene and catolene; it is extensively used for salad and culinary purposes, for packing sardines, and particularly for soap-making. It is also used, both in America and England for adulterating higher-priced lubricating oils. Indeed, so universal are the uses of this oil that, were it not for the tariff wall which shuts it out from Italy, the peasants of that country would use it in enormous quantities for edible purposes in place of Olive oil; while Spain, the country of olives, has been obliged to protect that important industry from certain demoralisation by enacting that a gallon of creosote shall be put into every barrel of cotton-seed oil which enters Spain. In fact, to enumerate the many uses of cotton-seed oil would fill a few columns of our space. But the latest (and, to India, the most important) use for this oil is that announced at the Tenth Annual Convention of the Inter-State Cotton-seed Crushers' Association, held at Atlanta, U. S. A. last month. It is generally supposed that Cotton-Seed Meal is used only as a feed for stock or for fertilising purposes; but Professor Connell, of Texas, showed samples of bread made from the meal mixed with wheat flour, which took the convention by storm. Professor Connell said:—"A combination of cotton-seed meal with other bread stuffs, will greatly enrich the flours and meals we now use, at the same time decreasing the cost to the consumer. In a short time, we may announce that the South has 4,500,000 tons of new bread-stuffs fit for human consumption." Here we have a 'famine-food' that ought to prove a most valuable stand-by to the people of this famine-ridden land. The Department of Commerce and Industry might make a note of this.

—ENGLISHMAN

ROYNA OR *BAIDYARAJ* (বৈদ্যরাজ) OIL

A tree known in Bengal as the *Baidyaraj* tree, grows plentifully in the forest of Bengal. It is known by different names in different parts of the province. In some districts, it goes by the name of *Baidyaraj* or *Pitraj* (পীতরাজ), in others, *Royna* (রয়না). This tree requires very little care for its

growth. The fruit of the tree ripens in October and November, when it bursts and the red seeds drop down. The external covering of the seed being taken away, the seed appears really to be black. The red covering generally separates on exposure to the sun. The seeds are pounded down and dried in the sun. The powdered seed is next boiled in water for a long time in a vessel, and the vessel is then allowed to cool down. When the liquid cools down, the oil appears on the surface like a crust. This crust is carefully taken out and exposed to the sun, and we have *Baidyaraj* Oil. The liquid of the vessel, being boiled again for sometime, yields a further small quantity of oil. In former times, *Baidyaraj* Oil was freely used in lamps. The peasants of Bengal had thus a cheap and inexpensive source of oil-supply. But, now, kerosene oil has taken its place.

One *Baidyaraj* tree yields an enormous quantity of seeds. If the work is started on a commercial scale, an oil-pressing machine should be used to separate the oil from the seeds. Five seers of seeds will yield approximately two seers of oil. A profitable industry can thus be started which would not require big capital.

CHAULMUGRA OIL

The latest issue of the "Agricultural Ledger" from the Reporter on Economic Products, contains an account of the Chaulmugra-seeds of commerce, which afford an oil extensively used as a specific for leprosy. The seeds have been used in India for this complaint for at least over a hundred years and are described in old Mahomedan works of medicine. European doctors in India were attracted to this remedy about fifty years ago, and after observing its efficacy, the oil was promoted to a position in the Pharmacopœia. In this work. it is recommended as an alterative tonic in cases of leprosy, scrofulla and other skin diseases and rheumatism. The oil appears to have been first used experimentally in England in the seventies, and of late years, the knowledge and use of the drug have spread to Europe and America, where it appears to be increasing in favour and reputation.

The origin of the Chaulmugra-seed of commerce, has long been supposed to be of a tree named "*Gynocardia Odorata*," but mainly through the research of Colonel Prain, of the Botanical Survey of India, the true source is now traced to a tree with the

not very euphonious name of "*Taraktogenos Kurzii.*" Both these trees yield oleaginous-seeds and grow in Chittagong and Sylhet; but while the former is found in Sikkim and the Brahmaputra Valley in Assam, the latter is widely distributed in Burma. The seeds are easily identified by examining the kernels.

Chaulmugra-seeds are brought to Calcutta, chiefly from Chittagong, and, as sold in the market, are of two kinds,—(1) mature seeds with a brown kernel rich in oil, and (2) immature seeds with a black kernel, containing a smaller proportion of oil of a dirty colour. The seeds arrive in the market at the end of the rainy season, in November and December. The seed comes from the Kassalong Reserve in the Chittagong Hill Tracts, where the tree is plentiful, and is exported from the Reserve, down the Kassalong River into the Karnafuli River and down the latter to Chittagong. There is no check on the export from the reserved forests of the Hill Tracts, as at present no Government tax is levied on it. The seeds are brought out of the forests by Jamchas and are sold by them to the Bengalis at Kassalong.

Chaulmugra-seeds formerly sold in Calcutta at Rs. 5 to Rs. 7 per maund. In 1893, the supply in the market was small and the seeds were selling for Rs. 13 per maund. Occassionally, they are sold by public auction. The present price is Rs. 3 to Rs. 4 per maund at Chittagong and Sylhet. and the Calcutta price Rs. 6-9 per maund. The trade is confined to a few Bengali merchants, and the quantity disposed of yearly is 5,000 maunds. Bombay and Madras, as well as foreign countries, are dependent upon their supplies from Calcutta.

To extract the oil from the seeds the kernels are separated from the shells and dried in the sun. They are then partially pounded in a pestle and mortar, such as is used for husking rice and pulses. The broken kernels are then put into canvas pads, and the oil is expressed with the aid of fire in a castor-oil mill. Sometimes, the oil is expressed in a native oil-mill, but this method is attended with waste of oil in the refuse cake. As a rule, the oil is not refined. There are two kinds of oil known, *viz.*,—(1) clear, bright, straw-coloured, (2) muddy and precipitating a sediment of earthy colour. One maund of oil is obtained from about four or five maunds of seed. The price of the oil is Rs. 60 per maund.

Chaulmugra, like most beneficial remedies, has its substitutes and three of these so called "False Chaulmugras" are described in

the "Ledger." The first is the oil from Gynocardia-seeds which has quite a different composition to the official oil. The second is the oil, separated from the seeds of "*Hydnocarpus Wightiana,*" a tree indigenous to the Western Peninsula from South Concan to Travancore. This oil has been used in the Bombay Presidency with satisfactory results. The third is the oil from the seeds named "Lukrabo" and "Ta-fung-tsze" derived from "*Hydnocarpus anthelmintica,*" a tree indigenous to Siam. The peculiarities of these seeds and their oil compared with true Chaulmugra, are pointed out in this interesting number of the "Agricultural Ledger."

Camphor

ITS INDUSTRY IN INDIA

The camphor industry affords several points of interest to India, not only because so much camphor is consumed in this country, but also because India is a possible country of production. The most noteworthy fact in the recent history of camphor, is the fact, that the supply of the crude material is no longer equal to the demand. It is estimated that the shortage, last year, amounted to 2,400,000 lbs., and this year, it is expected to be between 1,000,000 lbs. and 1,500,000 lbs. The present scarcity dates from the latter part of 1903, when the stocks held by the selling agents became exhausted. From that time up to the present, the demand for crude camphor has been supplied from the immediate production, which, as stated above, was last year considerably less than the estimates. The result is a high price for crude camphor; and this would undoubtedly be still further advanced, did the Japanese Government, who are the chief factors in controlling the world's supply, so desire. On the other hand, the significant statement is made, that the only reason why such an advance will not be made, is that Government "do not wish to encourage too deep a research into chemistry for an artificial substitute." We have, before pointed out that, synthetic camphor is being produced in commercial quantities; but it is probable that, when normal conditions prevail again in Formosa and Japan, as they doubtless soon will; the synthetic product will be unable to compete in price with the natural.

Celluloid makers are the chief users of camphor, and they will not be best pleased to hear that the Japanese are themselves about to undertake the manufacture of that substance. What

is worse news still, however, more especially to the camphor-grower, is that a new manufacture has recently been invented in Germany, which is said to be as good as, if not better than, celluloid! "*Galalith*," which means milk-stone, is the name of this new substance. It is made by treating casine with *formic alehyde*, a hard substance, similar to ivory being produced which, it is said, can be turned, carved and moulded, and is already competing seriously with celluloid. There is a factory for its manufacture at Hamburg, and another at Levellois-Perret, near Paris. It is certain that, if *galalith* is as good as it is reported to be, a large part of the considerable demand for camphor by celluloid makers, will cease.

The scarcity in the supply of crude camphor led the United States Government recently to instruct their Consuls in Japan and Formosa to report on the camphor industry, and as a result Mr. Fisher, their Consul-General at Tasui, Formosa has written a comprehensive Report in reply to a series of questions, addressed to him by the State Department at Washington. This report is, to a large extent, a review of the history of the industry since 1889, when camphor was made a monopoly by the Japanese Government; but in addition, some new and interesting facts are brought to light. Mr. Fisher attributes the scarcity of camphor to lack of labour in the forests, which, in Japan, was due to the Russo-Japanese War, and in Formosa to the War and the attacks of the natives, who have driven the workmen out of the camphor districts. The termination of hostilities has relieved the situation somewhat, but Mr. Fisher does not look forward to the restoration of normal conditions before the end of 1906, although the Formosan Government are energetically at work, putting down the native troubles. The most valuable camphor forests, it must be explained, extend over an area of about 180 square miles in North Formosa, and are infested with savages, who are inveterate head-hunters. New plantations, it is said, are also being opened by the Japanese Government in South Formosa. Discussing the conditions in that island, Mr. Fisher states that while it has an advantage in cheap labour, the inadequate means of transporting the raw material from the forests, is a great disadvantage, adding materially to the cost.

A Report on Chinese camphor has also just come to hand. This too, is the work of an American Consul, Mr. G. E. Anderson by name. He writes from Amoy, and describes the camphor trade

of the Fukien Province, where, two years ago, the Japanese obtained the exclusive right to buy camphor from the Chinese citizens of the Province. The main object of the Japanese was, of course, to be able to control prices and prevent the Formosan camphor market from being unduly acted. They have not however, been able to maintain the entire monopoly of the camphor business. Of late, a considerable amount of camphor has been brought down from the interior; and it is probable that the exports for last year will, when the figures come to hand, show a substantial improvement. At present, the Chinese complain that the Japanese monopolists will not pay more than two-thirds of the value of the camphor brought down, so the latter, even if they cannot maintain the monopoly they desire, appear able at any rate to manipulate matters in China, at the present time, in a way that works very much to their own ends.

Supposing, it is found impossible to cheapen the cost of production of the synthetic substitude, what is there to prevent camphor from some day, holding sway for a spell among planters in India, Ceylon and the Straits Settlements, in all which countries it is known that it thrives? Sir W. Thiselton-Dyer, late Director of the Royal Botanic Gardens, Kew, called attention to its possibilities a year ago, and he has not often been found to be wrong. "I have long urged the cultivation of camphor,"—he wrote to H. E. Sir Henry Blake, Governor of Ceylon; and further evidence that camphor may prove to be well worth attention is to be found in the interest taken in this product by the Government of the United States. Recent experiments in extracting camphor from the leaves and twigs of the camphor-tree as well as from the stem, have shown that the drug can be economically produced in that way; and the Japanese monopoly bureau, we are told, intends to apply the new method, as soon as the trees planted a few years ago, have reached their seventh year. But the amount produced in this manner, will only be a small proportion of the total. This announcement is interesting however; because it was said some time ago that camphor trees were to be grown in Ceylon 6 ft. apart and camphor and oil were to be distilled from the clippings. Whether or no, this industry is progressing, we have not heard. It is probable that in the rush to get in rubber, few, if any, have the patience to dally with camphor. Yet some day, perhaps, Ceylon planters will be as mad over camphor as they are to-day over rubber,

The chief feature of tropical agriculture is the transitoriness of each successive product. In the Straits Settlements, we learn from an interesting paper by Mr. H. N. Ridley, Director of the Botanic Gardens, Singapore, on "The History and Development of Agriculture in the Malay Peninsula" that European planters for 60 years pinned their faith to nutmegs and cloves; thereafter for 22 years to Liberian coffee; and for the last 10 years to rubber. Native planters have in the meantime taken up the cultivation of pepper, gambler, tapioca, indigo and pineapples. Even more remarkable have been the transitions in the history of Ceylon agriculture, a fact, which was specially brought out in the admirable "Sketch of the Agriculture of Ceylon" compiled a short time ago, by Mr. J. C. Willis, Director of the Royal Botanic Gardens, Peradeniya. The halcyon days when "King Coffee" ruled supreme, there are now but a memory. Likewise cinchona has had its brief day and is neglected; for some time past, moreover men have been saying that tea's best days are over. And Sir Henry Blake, the Governor of Ceylon, it may be remembered, when speaking to a community of planters a year ago, alluded to the possibility of tea cultivation in the island being given up in favour of other products, such as rubber, silk and camphor.—ENGLISHMAN.

PRODUCTION OF CAMPHOR IN FORMOSA

("Evening Post," New York.)

The production of camphor in Formosa under Government monopoly is treated of in a report from Consul Fisher of Tamsui. On August 5, 1899, the camphor industry of Formosa was placed under Government monopoly. The chief reason for this action, was to increase the revenues of the Government. Other reasons were to raise the standard of quality of camphor manufactured, to regulate the production with regard to future supply, and possibly to give the Government a more free hand in carrying out its policy toward the savage tribes, in whose territories practically all of the remaining camphor forests exist. The conditions under which the monopoly has been conducted, since it was created, so far as the manufacture of camphor is concerned, are as follows:—

Persons wishing to engage in the manufacture of camphor in the forests, are required to obtain permission from the Government. They must furnish an estimate of the amount of camphor they expect to produce during the ensuing year, which must be of a quality not below a certain standard fixed by the Government. All of the camphor, as well as

camphor oil, produced must be sold to the Government at prices fixed by it, according to the fineness of the product. Besides accepting deliveries at its main office at Taihoku, the monopoly bureau at first established stations throughout the camphor districts, at which the camphor was accepted from the manufacturers. For camphor delivered at one of the stations, a sufficient amount was deducted to cover the cost of transportation to Taihoku, and the loss in weight that would result while in transit.

The Government supplies to the manufacturers two sizes of canvas bags, one-half *picul*, and one *picul*, in which the crude camphor is shipped to Taihoku, where if it is to be exported in its crude form, it is well packed in zinc-lined cases or tubs holding about one *picul*. The monopoly bureau has a factory at Taihoku, for cleaning and pressing such as is to be exported in a semi-refined state, which consists of redistilling and compressing into blocks weighing ten *kin* (13-1-3 pounds). Ten of these blocks are packed into a zinc-lined case. A very small proportion of the camphor is now exported in the semi-refined state. When packed, camphor is marked and turned over to the sole selling agents. Although the Government factory is equipped for extracting camphor from the oil, the most of it, is delivered to private refineries in Japan which, under an arrangement with the monopoly bureau in Formosa, extract the crude camphor and deliver it to the bureau's branch office in Kobe. The oil is supposed to yield about 49 per cent. of crude camphor. The residual oils are used in the manufacture of disinfectants, perfumes, soaps, etc.

When the monopoly in Formosa was created, the camphor industry in Japan had almost ceased to exist, as the trees easily available had been exhausted. With the advanced prices set by the monopoly, the manufacturers in Japan found that they could produce camphor from the trees, even, though difficult of access, sell it at prices considerably under those of the monopoly, and still realize a good profit, so that the industry there quickly revived. The annual production, which in 1899 amounted to but 1,416,260 pounds, was increased to 2,190,175 pounds in 1900, to 2,669,292 pounds in 1901, and to 3,396,908 pounds in 1902. Moreover, at the time of the enforcement of the monopoly, large stocks of camphor were held in Formosa by private persons, with the disposal of which the Government did not interfere. While Japan's production was capable of supplying but a portion of the world's demand, the selling agent found that it would be

impossible to maintain the monopoly's original prices and dispose of the whole of the amount stated in their contract. The monopoly was, therefore, appealed to for a re-arrangement of the terms of sale, which was granted.

This was in the latter part of 1901. In the meantime, the selling agent had acquired large stocks. As the Formosan Government had depended upon the profits of the camphor monopoly for a part of its revenue, it was necessary that some steps should be taken to relieve the situation, and with this in view, a bill, emanating from this Government, was submitted to the Imperial Diet in 1902, the object of which was to give the monopoly bureau of Formosa an indirect control over the production and price of the Japanese article. Owing to a technicality, the bill did not pass that Diet, but it was plain that some such bill would be passed at its next session. During the season of 1901-2, there was a large production in Japan. The monopoly's prices were forced downward until in June and July, crude camphor was sold abroad at 135 shilling per hundredweight (112 pounds), but by the first of August, most of the Japanese production had been exported. From that date, the monopoly was enabled to raise its prices and by the end of the year crude camphor stood at 160 shillings abroad. The bureau had, during that year, reduced its receipts from the manufacturers to nearly 1,200,000 pounds less than those of the preceding year.

The next season's (1902-3) production in Japan again forced the monopoly's prices downward. In July, 1903, it delivered crude camphor abroad at 150 shillings. In the meantime, the 1903 session of the Imperial Diet had passed a bill placing the industry in Japan under Government monopoly, which was to be enforced from the first of November of that year, and as the largest part of the Japanese production had been disposed of by August, the monopoly's price for crude delivered abroad was raised to 155 shillings per hundredweight during that month. In March of 1904, the price advanced to 162 shillings, 6 pence; in September to 166 shillings; and in April, 1905, to 175 shillings, where it stands at present. While the camphor monopoly bureau in Japan is independent of the bureau in Formosa, they both exist under one law, and the prices and production are regulated in unison.

At the time of the enforcement of the camphor monopoly in Japan, a number of private refineries were in operation there. Instead of taking over their properties and granting compensations, the Government permitted

them to continue operation, and arranged to allow them a certain amount of crude camphor for refining, the product of which they are allowed to dispose of either at home or abroad. The amount allowed them is 8,000 *piculs*, or about 1,067,000 pounds, a year. This is manufactured chiefly into tablets for export. The price at which the crude camphor is turned over to these refineries is not given out, but from figures furnished in the customs returns of Formosa, it is about 90 yen per *picul*. At any rate, it is considerably less than the price of crude camphor delivered at New York, minus freight and other charges, and they are enabled to export their products to the United States in competition with the refineries in America.

The Government at present puts up three grades of camphor—the "A" grade, which is partically a refined camphor; the "B" which is about 97 per cent. pure, and the "BB," which is about 95 per cent. pure. The "A" constitutes only about 6 per cent. of the total exportation. The proportion of the "BB" is somewhat larger than that of the "B." The American market is supplied almost wholly by the "B." In order that camphor might be distributed to the different markets without partiality, the Formosan Government endeavours to apportion the exports to the different countries according to the proportion that each received at the time the monopoly was enforced, which was somewhat as follows:—Germany, 37 per cent.; America, 33 per cent.; France, 15 per cent.; Great Britain, 10 per cent.; and India, 5 per cent. Recent investigations as to the supply of camphor trees in Formosa have shown that with the present system of afforestation, there is no probability that the material will ever become exhausted, even though the demand for camphor should continue to increase. Vast forests in the south yet remain untouched, and it is now known that the supply in the savage districts of the north is much larger than was at first estimated.

The question of manufacturing celluloid in Japan has been under consideration for sometime, and that industry will probably be undertaken before many years. It appears that if such a thing be possible, users of camphor in the United States would find it to their interest to arrange for their future supply by afforestation in localities, either in our island possessions or in the United States, adapted to producing the drug, if they expect to continue their business far into the future. While the camphor industry in Formosa has an advantage in cheap labour, it has disadvantages in the inadequate means of transporting the material from the forests and

in the necessity of maintaining a large force of guards for protecting the workmen from attacks by savages, neither of which will be overcome for many years. Recent experiments in extracting camphor from leaves and twigs of the camphor tree have shown that the drug can be economically produced by that method, and that the monopoly bureau here intends to apply this method as soon as the trees in a few years have reached their seventh year. However, the amount produced in this manner will be a small proportion of the total production.

The Formosan Government does not intend to advance the price of crude camphor during the next year. The Government is naturally reticent in giving out any information regarding prices, so the statement is not official. With the enormous shortage in the present supply, it would appear that an advance of say ten shillings per *picul*, could easily be maintained, and the only reason why such an advance might not be made, is that the Government does not wish to encourage too deep a research into chemistry for an artificial substitute. The present price of the "B" grade, cost, insurance, and freight, New York, is 175 shillings per hundredweight of 112 pounds, or 100 yen per *picul*. The direct cost (not including maintenance of the camphor bureau) to the Government for this grade, delivered to the selling agent, is about thirty-five yen per *picul*.

CAMPHOR CULTIVATION

I.

A planting correspondent writes to the "Madras Mail" :—The price of camphor keeps up, which fact is due, it is said, to the unusually good demand for both pharmaceutical as well as industrial purposes. Labour is stated to be scarce in Formosa just now and this difficulty, it is said, is retarding the industry and diminishing the output, but it is not believed that there is any arbitrary curtailment of shipments with the object of controlling the market. Those who think of ordering seed from Japan should not delay, as the time approaches when this seed ripens in that country. The Yokohama Nursery Co., Limited, offers seed of "Cinnamomum Camphora" at 70 cents (American) per lb., and in a page devoted to cultural directions for the plants, we are told that for 1 lb. of seeds, which should give 2,000 plants on the average, a space of six square yards is usually allotted, but the more sparsely sown the better for the growth. In the second year the plants should be moved

into a second nursery. They *should be planted out at the rate of 20 to a square yard. In the* Spring of the third year the plants, *with* tops and roots again cut back in *the* same way, are ready to be removed to a permanent quarter. This second transplanting may sound useless waste, says this Japanese authority, but on the other hand "the double precaution may save much in the end." Giant camphor trees several centuries old are, it is said, invariably to be met with in Southern Japan in the precincts of the shrines and temples, and we are told that "the people feel from traditional instinct a sacred sentiment towards the tree, but science has revealed the truth that it serves as a natural purifying agency against pestilential atmosphere." It would be interesting to know the dimensions of the largest camphor tree in India. Mr. Proudlock, Curator of the Government Gardens and Parks on the Nilgiris, mentions in his latest Report a tree planted in the Burliar Garden in 1899. It measured 30ft. 4ins. in height in March last and in girth 4ft. from the ground 16in. Ceylon-grown seed also is being advertised, in the Colombo papers and good seed is said to be obtainable in Queensland.

II.

(Special for the "**Patrika**".)

I have read the correspondence on the above subject in the "Madras Mail", contributed by a planting correspondent of the said paper and reproduced in the "Patrika" (Bi-weekly edition) in its issue of the 23rd August last. Camphor is not only valued for its great demand for pharmaceutical and industrial purposes but also for others.

Camphor is extracted from the stem, twigs, bark and also from the leaves by mechanical processes. The oil extracted from the seeds is used for various purposes. It is much valued for its economic importance also. The wood of this plant is much used in Japan for the manufacture of cabinet, chest of drawers, wardropes, and boxes, etc. The timber of old trees bears fine close ring grains, clear-yellow-brown colour, silky sheen and beautiful appearance. It is, therefore, well adapted for veneering. Not being subject to the attack of insects owing to its strong odour, it is very useful for such works. Besides the odour of the wood, imparts a delightful fresh scent to the articles made of it.

It is also said that the use of the articles made of this timber partially saves people from the attack of malarious and other contageous diseases such as cholera, etc.

Apart from its economic value, it has an occult hygienic property as described by the writer of the correspondence in the "Madras Mail." These plants have power to absorb malaria gases, and to kill cholera germs. Dwarf plants will answer well to purify the atmosphere in the dwelling house when used in the parlour and veranda, etc. as pot plants.

Every house in Bengal specially in malarious districts should have at least half a dozen plants plantd in its precincts.

Besides the above properties, its evergreen nature, turtuous dense foliage, mighty form, extraordinary longivity and aromatic property are the features highly recommendable.

As regards its culture, I would simply add a few words to what has been written by the "Madras Mail" correspondent.

Seed bed.—Prepare a bed in well-fertilized and rich soil. Plough up 18 inches deep having the lumps finely broken, make dikes two feet apart for drainage and press the surface soil smoothly, then sow the seeds on it. Mid spring is the sowing season or when the temperature ranges above 50 degrees Fahrenheit. The seeds being sown; cover them up with half an inch deep soil through a seive. Straws or hay should be spread over the bed so as to protect the seeds from being washed away by storm, besides its getting too dry, until they sprout, care being taken to keep the straws in the place by sticks fixed into the ground. Watering occasionally according to requirements, is necessary. Evening is the best time for watering. The seeds germinate in one to three months and some times in six months.

This sort of variation is due chiefly to the atmosphere, moisture and temperature of the soil. The seeds retain their vitality for a long time.

Manuring.—Manure should be given in summer and autumn. Decomposed ordure mixed with oil-cake in a soluble stall is very beneficial and is much used in Japan. Bone dust or similar other manure will also answer the purpose.

As regards planting and transplanting, I need hardly add anything to what has been written by the correspondent of the "Madras Mail."

Soil.—Generally dry localities suit best for the cultivation of this plant. They may also be cultivated in moors, and hill lands.

Japan has now the monopoly of camphor trade. Formerly this belonged to the Chinese. Ceylon, Straits Settlement and Mauritius Governments are now very busy in camphor cultivation. Good seeds are available in Japan, and Formosa. They are also available

in the Phillipines, Queensland, Straits Settlement, Ceylon and Mauritius from September to December.

I grow camphor plants with ordinary care and sell them to the different Nurseries of Calcutta and elsewhere. They thrive well in almost all parts of Bengal. My plants have been much praised even by Mr. S. P. Chatterjee of Calcutta.

Camphor worth many millions of Rupees are exported from Japan to all countries on the globe every year. I would advise the well to-do men of my country to invest some money of theirs towards this useful industry.

Isvar Chandra Guha,
Jamalpur (Mymensingh)

Turpentine

ITS PRODUCTION IN INDIA

Turpentine is manufactured in a very small quantity in India, and the quantity consumed here is also not very great. But what is manufactured is wholly a Government monopoly. In 1890, Government opened a factory for the manufacture of turpentine at Naini-Tal and subsequently another at Jaunsar. The turpentine turned out by these Government factories have been declared by experts to be of as fine a quality as that imported from Europe and America. Indian turpentine is at present being used in Government Dispensaries, Hospitals and for military purposes. Not long ago, the financial Secretary of the United Provinces observed that the turpentine industry had now reached a successful commercial stage and that the U. P. Government should consider what steps should be taken for its extension and whether it might not be more profitably conducted by private enterprise. It is therefore evident that, manufacture of turpentine can no longer be continued as a government monopoly. We shall therefore be glad if the authorities will induce Indian Capitalists to take actively to this useful and important industry.

THE 'ENGLISHMAN' ON THE TURPENTINE INDUSTRY

There seems to be a good opening for a sound and profitable investment in the turpentine industry of the pine forests of the Kumaon Himalayas. During the year 1904-05, some 62,000 trees were tapped in the Naini Tal Forest Division, and they yielded 4,259 maunds of crude resin or 2·74 seers per tree. 6,128 gallons of turpentine and 3,318 maunds of *Colophony* (a bye-product) were

manufactured at a cost of Rs. 14,300 and sold for Rs. 29,830. There was thus a large margin for profit. The buildings and plant required are not of an expensive kind, and the total capital expenditure on this account does not appear to have exceeded Rs. 5,500. Turpentine fetches Rs. 2-4 a gallon delivered at Kathgodam, and *Colophony* Rs. 5-1-7 a maund at Cawnpore, and the demand is said to be larger than the supply. To quote from the forest report from which these details are taken—"the industry appears to be an assured success. It is still, however, in an experimental stage as it has not yet been found possible to come to any decision as to the amount of injury caused to trees by tapping, the loss of weight and strength in the timber, and with what intensity the tapping should be carried out. All this is being examined and *data* being carefully collected." The question is, would the Forest Department welcome the assistance of private enterprise in placing this apparently promising industry on a real commercial footing?

ESTIMATE FOR A TURPENTINE FACTORY

[Mr. Puran Chand, Analytical Chemist, (Tokio) in charge of the Hindu Technical Institute, Lahore]

Official reports show that vast qualities of turpentine oil are imported every year. We also import rosin and other bye-products of turpentine factories. In India, there is a vast field for this industry. Nepal has forests of pine trees. Kangra, Chamba, Jammu, Hazara, Dehra Dun, Tehri and other forests can, in my opinion, afford sufficient materials for, at least, ten turpentine factories, each handling 1 ton of raw material every day. Raw turpentine is obtained from the following species, by making seasonal incisions, which do no injury to the growth or the timber of the trees,—*Pinus Pinaster S. Maritima*, *Pinus Silvestris*, *Pinus Palustris*, *Pinus Australis*, *Pinus Parda*, and *Pinus Strobus*. From middle of February to the beginning of November incisions can be made.

The yield of turpentine oil ranges between 20 to 25 per cent. and that of rosin 60 to 70 per cent. Both these articles are of extensive application in every country.

The following is an almost exact estimate of a Turpentine

Factory that may work 1 ton of raw material every day.

CAPITAL—Rs. 50,000

	Rs.
Machinery and Building (Machinery includes Boiler, Engine, Stills, Sundry appliances, &c.) ...	10,000
Running Capital ...	35,000
Reserve Fund	5,000
Total ...	50,000

MONTHLY BALANCE-SHEET

EXPENDITURE :	Quantity in Maunds	Price Rs.
Raw material required per month (Rs. 5 per maund, including the State or Government Royalty amounting to 8 As. per maund and other gathering expenses)	840 ...	4,200
Establishment expenses	...	200
Manager's pay	...	500
Fuel and other expenses	..	200
Wear and tear of machinery, taking its life to be ten years ...	...	84
Interest of 5,184 at the rate of 5 per cent. per annum is about 260,		
Interest per month ...	. .	22
Total expenses .		5,206

INCOME :	Quantity in Maunds	Price Rs.
Oil at 20 per cent. ...	168 ...	4,200
(Selling at Rs. 25 a md., whole sale, deducting all commissions, etc.)		
Rosin at 65 per cent. ...	546 ..	2,184
(Selling at Rs. 4 per maund, deducting all commissions, etc.)		
Total ...		6,384
Nett Profit per month ...	...	1,178

This factory can be started even on a smaller scale. The raw material, the *Ganda Biroja*, can be had in sufficient quantity for such a factory from Amritsar, Jammu and other places, which is selling at equal rates with rosin the bye-product of the turpentine factory. Though individual efforts may succeed in reaping enough profits for its own labour, but, in consideration of great, open competition with foreign countries, we have to organise on a large scale.

The Punjab Government has been trying the experiment for turpentine manufacture for some time and the reports of the Forest Department show, that they were very profitable concerns, but from last year, the Nagpur Turpentine Factory is closed, with the remark that it was more paying to sell the raw material than the finished articles. I find that the Nagpur factory was worked with crude methods. Steam distillation has not yet been tried by the Government. The old kettle process is in favour. The Government reports betray some misgivings as to the life of the pine trees, from which it is extracted, but this is a wrong notion, if the tapping process is carried on judiciously. The other factory of the Government is attached to the Dehra Dun Forest School and it is working well. The pine forests

of Native States like Jammu, Patiala and other hill forests, if taken lease of, can supply the raw material for more than two factories. I strongly urge the importance of this industry on my countrymen.

WORLD'S SUPPLY OF PINS

Though the demand for pins the world over is enormous, the mills of the United States practically supply the entire demand. Formerly pins were expensive, but now they cost a mere trifle. In 1905, the 75,000,000 people in the United States used 60,000,000 gross of common pins, which is equal to 9,500,000,000 pins, or an average of about 126 pins for every man, woman and child in the country. This is the highest average reached anywhere in the use of pins. Ten years ago, we used only about seventy-two pins each.

In a single year, the total number of pins manufactured in the United States, was 68,889,260 gross. The total number of pins manufactured in the United States during 1900, the census year, was 68,889,260 gross. There are forty-three factories in all, with 2,353 employees. The business has grown rapidly during the last twenty years, for although there were forty factories in 1880, they produced only half as much, employed only about half the capital and only 1,077 hands.

There has been a considerable increase in the number of women and children employed in pin-factories of late years, which is an indication that the machinery is being improved and simplified and that its operation does not require so high an order of mechanical skill. Hooks and eyes are a bye-product of pinmaking and are produced at most of the factories from material that will not do for pins. The output of hooks and eyes in 1900, was 1,131,824 gross.

The automatic machines which turn out pins and hooks have minimized the cost of their manufacture till the cost is practically only that of the brass wire from which they are made. A single machine does the whole business. Coils of wire, hung upon reels, are passed into machines which cut them into proper length, and they drop into a receptacle and arrange themselves in the line of a slot formed of two bars. When they reach the lower end of the bars they are seized and pressed between two dies, which form the heads, and pass along into the grip of another steel instrument which points them by pressure. They are then dropped into a solution of sour beer, whirl-

ing as they go, to be cleaned, and then into a hot solution of tin, which is also kept revolving.

They here receive their bright coat of metal, and are pushed along, killing time, until they have had an opportunity to harden, when they are dropped into a revolving barrel of bran and sawdust, which cools and polishes them at the same time.

America imports $418,000 worth of ordinary needles in a year, most of them from England. Hair-pins and safety pins and other kinds of pins are manufactured in a similar manner. We made 1,189,104 gross of hairpins in 1890. Both needles and hairpins are manufactured to a greater extent in Europe than plain pins. Safety pins, however, are decidedly American.

PREPARATION OF SAFETY MATCHES

In view of the great interest that is now being taken by the public in the matter of preparing safety matches in this country, I give below the process of preparation from a most reliable authority on the subject:—

"Dip the splints in a paste composed of chlorate of potash, 6 parts; sulphide of antimony, 2 to 3; glue, weighed dry, 1. The paste for the rubbing surface is amorphous phosphorous, 10 parts; oxide of manganese, or sulphide of antimony, 8; glue, 3 to 6, weighed dry. The ingredients must be thoroughly mixed, and care must be taken not to mix the chlorate of potash in the dry state with the other materials; it should be mixed first with the glue dissolved in warm water. The past for the rubbing surface may be spread with a brush or spatula on the side of the box."

PANCHANAN KARMAKAR.
12, Hara Lall Mitter's Street,
Calcutta.

MATCH MAKING WOOD IN INDIA

(*a*) Samples of *Saral* wood which grows in plenty in the forests of Assam were sent to Japan for trial and they have been pronounced to be quite suitable.

(*b*) A kind of wood called *Geno* (গেঁও) available in the Sunderbans was much in use in the factory once started in Bengal and proved very suitable.

(*c*) The timber known by the name of *Palash* is used in the Kota Match Factory. It is commonly available in the forests of the Central Provinces.

(*d*) The stalks of *Dhanicha* plant and that of jute (*Pakati*), cut into small pieces and split up, have been found to be very servic able and entails but little cost in manufacture.

(*e*) The bamboo, sticks steeped in paraffin, have lately been extensively used by hand-made match-makers in Bengal, with no little success.

Paper Manufacturing

THE INDUSTRY

At present there are only two paper-mills in Bengal and it is admitted that the increasing demands for paper are not adequately met by the existing mills. We understand that the Government is making investigations to improve the paper-making industry of this country. Now that the Bally Paper Mills Co., have closed their concern and the demand of paper is daily increasing, it is time that our countrymen should form a company and start a mill at or near Calcutta. The services of Mr. M. H. Pettit, the able manager of that Company, who has 17 years' experience of the trade, can profitably be utilised by our countrymen by giving him opportunities for bringing his experience to bear on the development of the paper-making industry in this country. This is what Mr. Pettit writes to the "Journal" on the above subject:—

"European-made paper can be landed in India at low prices including the cost of freight and duty, and the question is often asked why cannot the country mills cope successfully with this competition? The cause undoubtedly, is, that paper manufacturers in other parts of the world, have met the needs of the time by acquiring the most improved labour-saving and economically-working machinery, yielding large outputs. Every decade witnesses the introduction of marked improvements in all branches of machinery, and particularly has this been the case with paper machinery; and there can be no doubt that the modern fast-driving paper machines possess great advantages over those of older date. The solution of the problem of profitable paper-making in this country is to construct a new Paper Mill with every modern improvement as regards the most fast-driving machinery, and the necessary appliances for the preparation of the pulp. Such a mill, carefully conceived and planned, and conducted with every possible consideration for economical working, would undoubtedly introduce an innovation in the Indian paper trade.

"You alluded to investigations being made in Burma by a wood-pulp specialist, engaged from England by the Forest Department. It will be interesting to learn the result of this gentleman's labours, but whether it is possible to obtain suitable wood-pulp or not, at a workable cost would concern a new mill but little. There is abundance of grass fibre, such as is now in use by the country Paper Mills, and this is a most excellent material. If, however, it is found to be practicable to obtain wood-pulp at a price near the cost of the same articles in other countries, no doubt an increased impetus will be given to the industry.

"An interesting item of information for Indian paper manufacturers comes from America. A paper manufacturer in the United States is about to organise a company which will make a fibre from cotton-stalks for the manufacture of the coarser grades of paper, such as are used in making sacks and bags for flour, cotton-seeds, meal, and like products. These cotton-stalks have been regarded hitherto as of no commercial value.

INDIAN FIBRES AND PAPER-MAKING

Mr. R. W. Sindall, who has been investigating, on behalf of the India Office, the suitability of Indian fibres for paper-making purposes, expressed himself as follows in an interview with a representative of the "Paper Mill" of New York:—In my opinion, the bamboo of India may some day supplant the spruce wood now being used in the manufacture of pulp, for paper-making. I have made a lengthy experiment, and have found that the bamboo is practical in the manufacture of pulp. I believe that capital can be secured, and I would not be surprised if a company were soon to be formed for the purpose of establishing a pulp and paper mill in Burma. While my investigation was conducted for the Government, the Government itself has no intention of building mills, but is simply desirous of ascertaining whether or not the raw product available in that country is good and can be used in the manufacture of paper. The pulp I now have in my possession as a result of my experiments, is an excellent white piece of fibre, and compares very favourably with the spruce pulp manufactured in the United States. The rice and straw found there can also be utilised in mak-

ing pulp, but the native wood, cotton-wood, is not good. Water power in India is very scarce, and in the event of a paper mill being established in Burma, steam power would have to be resorted to. Petroleum would be used as fuel, as it is obtainable there in large quantities and is reasonably cheap. The greatest item of consideration in competition with American paper manufacturers, would be labour. The people of India, for the most part, are infernally lazy; *(Sic.)* in fact, it is the women who do most of the work. The native of India can be employed for eight cents per day. He also investigated the matter of freight rates and found that pulp can be shipped from Rangoon, the principal seaport in that vicinity, to an English port for 1·35 dollar per ton. At the present time, there are three paper mills in India, all located near Calcutta. One has a capacity of 200 tons per week and another 150 tons. The third I did not visit. On my way home, I stopped at Shanghai, where I found the native Chinese manufacturing paper by hand. A unique process is employed in making this paper, and from the time they start on a batch to the time it is ready for market, one whole year has elapsed. The wood is beaten by hand and piled along the sides of mountains to bleach in the sun,

BAMBOO AND CANE INDUSTRY

The "Times of India" draws the attention of the Indians towards the bamboo and cane industry and deplores that in these days of Swadeshism when every attention is being directed towards industrial reform the improvement of work in bamboo and cane have attracted the least notice. The work of this class is far behind that of other countries, it is in the hand of very poor persons who live from hand to mouth and therefore bring out a very inferior quality of works. Cane and bamboo are materials of common use in India and if an impetus be given to this industry, it is certain that it shall rank next to weaving and shall return very high wages. All the best work that we see in this department in India is imported but if a proper encouragement to this industry be given, there is a chance of the goods being exported to foreign countries in excess to what is required for the home use. Due and proper attention should be given to this industry and we ask some of our wealthy brethren to take this work which is sure to prove lucrative.

CORK AS A WATERPROOF

A New Industry

What promises to be an important new industry is the application of cork to fabrics of all kinds and making them waterproof. Thin tissue-sheets of cork are it is claimed, inseparably united by chemical and mechanical treatment to silk, satins, woollens, cottons, linens, jutes, felts, leathers, wall-papers, etc., of any thinness or thickness. In the matter of price the article at present cannot be produced as cheaply as the cheapest waterproof, but the inventors claim that it is really a matter of future custom which will decide the ultimate cost of the production. The corketted material is certainly much lighter than rubbered cloth, and many articles can be corketted which cannot be rubber-proofed. It is certain also from actual observation that there is no odour about corkette such as is found with ordinary water-proofings, and it seems very strong and yet ductile in texture. The material should also prove extremely serviceable to motorists, as it is not so heavy as the ordinary garments that have to be worn and of course it can be applied to any kind of ordinary wearing material. For use in hospitals the material is likely to be extremely serviceable, for whereas after "postmortem" examinations ordinary mackintoshes are destroyed, this material can be boiled for hours if necessary and be as good as new. It has been a matter of considerable interest and curiosity to a number of people in the trade, who have lately been to the office of Mr. F. W. H. Durant, Insurance Agent to the Bradford Corporation, who is responsible for the formation of a small private Company in order to bring the material upon the market.

OX—THE USEFUL ANIMAL

Ox bones have a considerable value. The four feet of an ordinary ox will make a pint of neat's-foot oil. The thigh bone is the most valuable, being useful for cutting into tooth-brush handles. The foreleg bones are made into collar buttons and parasol handles. The water in which the bones are boiled is reduced to glue, while the dust which comes from sawing the bones is turned into food for cattle and poultry.

HORN COMBS IN MOURBHANJ

It is not widely known that in the Hill State of Mourbhanj, in Orissa, combs, etc., are made of horn, which if a little rough, serve their purpose well; as they sell at half-anna each, may well replace the imported article. With a little encouragement finer combs, etc. may be made and an impetus given to the growth of a paying industry.

CLOTH PRINTING IN DELHI

Babu Shama Charan Mukherjee of Delhi writes :—"I find a man here who prints chintz of various patterns,—quite equal to the imported article. So far only black colour is used; but the same is quite fast and stands washing; the designs are also numerous and pretty. Dealers in cloth at Delhi utilise the services of this man and pass off long-cloth printed by him as imported prints or chintz. A good and lucrative trade can easily be built up if a factory were established here with this printer in charge to make chintz out of the bleached long-cloth turned out by our mills." It is a good suggestion, well worthy the notice of those who desire the growth and expansion of India industries, and are in this line of business. Babu Nalin Behari Sirkar, whose firm has an agency at Delhi, may be expected to pay some attention to this suggestion of the correspondent.

FAST RED DYE

Fast red dyeing is rather difficult of attainment chemically. It was, however, an well-known art in India in ancient times. The Turks learnt the process of making red dyes from India and considerably improved upon it. In France, cloth dyed in red, began to be manufactured in 1765. Excellent red linen is now being produced in Glasgow. The Hindus, it is true, discovered the chemical process but the present red colour owes its brilliancy and brightness to the researches of Western Chemists. The details of the process are of a technical character and can only be appreciated by Chemists.

A certain professor of Chemistry in a Government College in Bengal is engaged since sometime ago in the direction of producing fast red colours, which would be cheap and commercially popular. It is hoped that the country may, ere long, reap the fruit of his well-earned labours.

INDIAN SILK CULTIVATION

(ENGLISHMAN)

Mr. J. W. Mollison, Inspector-General of Agriculture, has decided to start sericulture at Pusa, on a small scale. With this object he has sent a man to study the methods adopted on Mr. Tata's silk farm at Bangalore, which is managed by a Japanese artisan, and it is intended to study closely in the same manner the methods pursued in Bengal. Mr. Mollison in illustrating his method, advises the Baroda Durbar, which is experimenting in sericulture to follow the same course. The Gaekwar of Baroda is well-known for his keenness in developing any scheme for the benefit of his people, and with this end in view, Mr. Mukerji, Assistant Director of Agriculture in Bengal, was invited by the Baroda Durbar to report on the possibilities of the State with regard to sericulture. Mr. Mukerji made a study of the conditions in the various Districts of the State, and he reports that the culture is practicable in the Naosari, Songadh and Amrili Districts. He devoted three months, to the work, and in that time he remodelled the work at Songadh, introduced a new reeling machine, the best varieties of mulberry trees, and generally gave a new impetus to the industry. Mr. Mukerji's notes which are embodied in a report issued by the Baroda State, will be found of interest by all concerned in sericulture in India. Fourteen years ago, sericultural experiments were started in the Baroda State but the silk worms died from disease, and interest in the work languished. Recently the matter was taken up again; students were sent to Berhampore to study the methods there, and Mr. Mukerji was invited to vist Baroda. He is hopeful of the results if the matter is seriously taken up and the people educated in the best methods. He states that he would not advise the adoption of any Japanese methods of rearing and reeling as practised at Bangalore. While experimenting in Baroda, Mr. Mukerji devised a modification of the Bengal reeling machine, with a pedal arrangement which allows the machine to be worked by one man instead of two. Further experiments in Calcutta have confirmed him in the belief that this machine will prove satisfactory. Rightly, he attaches great importance to instructing the people in rearing of silk worms and the manipulation of the silk. He adversely criticises the methods he found obtaining in Baroda and outlines a practical scheme that should commend itself not only to the Baroda State, but to all districts where it is intended to go on for sericul-

ture. Mr. Mukerji states that though the roughly reeled silk of Mysore finds a ready-market, it is only because better silk is wanting. And apart from the Indian demand, there is Europe which is always prepared to take silk that has been properly handled. "There is no agricultural industry that I know of which brings such heavy return per acre such as Rs. 600, but without expenditure and carefulness this cannot happen. Sericulture is one of the high class agricultural industries." In fact, more knowledge and care are required on the part of cultivators than in other industries, but the silk industry, if firmly established pays well. The Baroda State in the interests of agriculturists have faced the question in a thoroughly practical manner, and it only remains to impress on the people the necessity of efficient methods to make the industry an important factor in the prosperity of the State. Mr. Mollison at Pusa should be able to do a great deal for the Indian silk industry. In many districts, the old rule of thumb methods are followed to the hampering of the industry. There is always the difficulty of persuading the cultivator to abandon old methods, but experience in India has shown that this is only a matter of time and example. The training of boys in schools and on experimental farms is the surest method of bringing home to the people the advantages of system and carefulness.

SILK IN BENGAL

Though much attention is paid now-a-days to the cultivation of the mulberry tree and the rearing of the cocoons of the silk-worm, and the prospects of sericulture are looking up all over the country, particularly in Bengal, one has to look for the glories of Indian silk-manufacture in the recods of the past.

The manufacture of silk is believed not to be indigenous to India. A passage in the *Mahabharata*, referring to the people of China bringing silk and silk-worms as tributes to Yudisthira, and another in Kalidasa's *Sakuntala* referring to silk as *Chinangsuka*, distinctly go to prove the Chinese origin. Thanks to the efforts of the Bengal Silk Committee, a great impetus has been given to the industry in Bengal, which is fast recovering from its state of decadence into which it had fallen.

In Mirzapur Thana of the Murshidabad District, we learn from the Administration Report, silk cloth is woven of good quality and the value of the outturn in 1904-05 was nearly Rs. 77,000 as against Rs. 42,000 in the previous

year and only Rs. 14,000 in 1900. The demand is said to be gradually rising, and the local industry seems now to have a prosperous future before it.

SILK INDUSTRY IN MYSORE

The following notice of this Industry in Mysore appears in the latest (May) number of the "Industrial India." "The Silk Industry of Mysore is not very old. It dates from the reign of Tippu Sultan. Within the last twenty years, a distinct revival is being noticed, and in the field of enterprise we not only notice the firm of the late illustrious Mr. Tata, but also several European firms, the last to enter the arena being Messrs. Arbuthnot and Co., who already own large coffee estates in the Province. The silk industry, however, is still mainly in the hands of Mahomedan cultivators, who rear the cocoons and reel the silk. By making plantations of mulberry trees and setting up reeling factories, the European and Parsi firms are likely to be able to develop the industry to a pitch hitherto unknown. The class of cocoons (the *Bombyx meridionalis*) with which Mysore is concerning itself, is far superior to either the *Bombyx croesi* (the *Nistadi*) on the *B. fortunatus* (the *chotapalu*) of Bengal. The latter yield a seer of silk out of 16 or 18 *kahans* of cocoons, while the former out of 11 or 12 *kahans* only. In this respect, as well as in the matter of climate, Mysore has a great pull over Bengal; and now that Parsi, Japanese and English enterprises have joined hands to lift up the industry, we hope to see great improvements in the near future." How we wish that such stimulus was given to this most important and paying industry by the united exertions and co-operation of the Japanese, Parsi and European enterprising men. The fact is the only farm—of Mr. Tata—that was doing much towards the betterment of the industry under a Japanese expert, has been since closed; and Mr. Partridge, the only European, who has been in the field for over 5 years and in whose case the Government has been exceptionally liberal, is never heard of as to what he is doing in the line of improvement. Messrs. Arbuthnot and Co., have just stepped in, and we have yet to see their performance. If, but a tenth of the encouragement and assistance given to them were only extended to the Mahomedan silk worm rearers by way of direction, they would have shown better results. But the law is "poverty is most despicable."—"Mysore Herald."

There is a factory in Bangalore owned by Mr. Tata, where the Japanese method of reeling is

followed, which gives a superior quality of silk yarn.

SILK CULTIVATION IN CENTRAL PROVINCES

Mr. N. G. Mukerji, Assistant Director of Agriculture in Bengal has been investigating the subject of *tussar* cultivation in the Central Provinces. He finds it deteriorating owing to the increasing difficulty that growers experience in obtaining wild cocoons, and their reluctance to use the large hard cocoons, which give the best seed, owing to their irregular and often long delayed eclosion. Mr. Mukerji suggests that wild cocoons should be obtained through the agency of the Forest Department from certain specially reserved areas where the wild strain is unlikely to have been effected by proximity to semi-domesticated moths, and that this wild strain should be bred for sale at a few selected centres. He does not discuss the possibility of rearing the worms under complete domestication, nor the question whether a market could be found for any largely increased outturn of *tussar* fabrics. The Central Provinces Government regards the suggestions for developing the silk industry with a favourable eye, and the Director of Agriculture has been asked to submit proposals for the starting of a *tussar* silk *bari*, with the two-fold object of supplying good seed and demonstrating the best methods of cultivating the insect and of reeling the silk. During last year an Agricultural Assistant was deputed to Bangalore to learn the Japanese system of reeling introduced by Mr. Tata. He reports that it is about five times as rapid as the Sambalpur method, but it results in the production of raw silk, and it is uncertain, whether this will be suitable for the kind of fabrics produced in Sambalpur, where twisted yarns are required. Since his return from Bangalore, the Assistant has been investigating the methods of reeling adopted in Bengal. There is very little doubt, that by experiment and investigation of this kind, valuable assistance may be rendered to an indigenous industry that without such aid is likely to decay if not to die out altogether. If the fabrics turned out are of good quality, there need be no fear of overstocking the market, for the demand will, in all probability, grow faster than the production.

An energetic attempt is being made to establish the industry on a firm foundation and orders have lately been issued by the Local Government with the object of discovering and making available forest areas, suitable for the rearing of the silk moth. An inquiry

is also to be made as to the amount of cocoons obtainable from the wild *jungle* through the Provincial Forest Department, and every encouragement is to be given to the planting of trees whose leaves are best adapted to the purpose. In due course, demonstrations will be given of the best methods, first of cultivating the insect and secondly of reeling the silk. The Japanese methods, which are already practised with great success in Bangalore, will be introduced as rapidly as local prejudices in favour of indigenous methods can be overcome.

SILK IN KASHMIR

The Kashmir Silk Industry is reported to be going ahead with great strides this year, and being a State industry, the Durbar ought to secure a considerable revenue from it. It is said to be noteworthy that Kashmir silk is now beginning to be preferred to Japanese on the continent, and if its ascendancy continues as at present, the former product is bound before very long to take a very prominent place in European silk markets. The remarkable progress and success of Kashmir sericulture has been largely due to the fact that in Sir Thomas Wardle—the well-known silk expert at Home—the Durbar secured the advice and co-operation of the proper man to push their industry. As an expert with a long and keen knowledge of sericulture in India he recognized at once the possibilities of Kashmir silk and in the present flourishing state of the industry, there is ample proof of his foresight.

SERICULTURE IN CEYLON

The local experiment in sericulture says the "Ceylon Independent" so far as the rearing of the *eric* worm goes, has succeeded, the industry being taken up largely by villagers even in remote districts. The village sericulturist is encouraged by his stock being purchased on the spot, Mr. Alex, Perera, the Assistant to the Superintendent of School Gardens, going round and making purchases. So far 200lbs. of dried cocoons have been received at the Colombo Stock Gardens, which represents, taking 900 cocoons to the lb., which is a fair average a total of 180,000 cocoons. The itinerant cocoon purchaser has just started on a tour in the Central Province, and another 75 or 100lbs. are expected to be brought in. Messrs. Freudenberg and Co., have sent to Germany a 50lb. sample of *eric* cocoons

while negotiations are also being carried on with silk merchants at home.

The silkworm experimental station at Peradeniya is fulfilling the expectations formed of it, says the "Ceylon Observer," and the outturn of cocoons is rapidly increasing in amount. The interest originally aroused in silkworm cultivation by the practical encouragement given to it by the Agricultural Board is being steadily maintained, and a large number of amateur cultivators have started it. The uncertainty of finding a ready market for cocoons need not now deter would be cultivators, adds our contemporary, as Mr. Joseph Whitehead is prepared to buy them in any quantities at Rs. 1·50, per lb.

THE *TASAR* SILKWORM (DOMESTICATED)

It will be interesting to the silk world to hear that an experiment, by Miss. B. Brown of Vizianagram, in domesticating the *tasar* silkworm, has proved a success. This worm in a wild state produces the best of the silks of India and now that it has been domesticated, it provides a new source of supply for filatures, as under the methods adopted, it can be raised in the vicinity of these machines, which can be worked satisfactorily by hired labour, while the rearing provides a home-work for women. This domestication of the *tasar* silkworm is the greatest advancement that has been achieved for many years in the silk industry, and should be fruitful in results.

THE SILK INDUSTRY IN BURMA

There is nothing authentic in the way of records to show whence the silk industry was introduced into Burma, but the concensus of expert opinions based on certain striking historical facts and references point to China as the fountain head and this conclusion is further substantiated by the significant fact that silkworm culture was introduced into Europe from China. Perhaps, the consideration of the abode of those forms of food most congenial to the silkworm, *viz.*, the mulberry tree which is said to be indigenous to China, may be relied on as a safer basis in accepting China as the birthplace of the silkworm. According to some authorities the industry is said to have existed in certain portions of Burma in the earlier part of the 19th century. However this may be, the first reliable statistics showing the centres and the

population engaged in sericulture are to be obtained from the Census Report of 1891, which shows that a total number of 2,229 souls were silkworm rearers and cocoon gatherers, the number in the six most important centres being 1,603 in Prome; 776 in Toungoo; 310 in the Pyinmana Sub-Division (Yamethin District); 279 in Magwe 70 in the Lower Chindwin and 32 in the Pakokku District. Since the census, the industry appears to have died out in several places, and at present the only centres where the occupation on a languishing scale still exists are the Prome, Toungoo, Pakokku, Thayetmyo and Magwe Districts. Sericulture on a lesser scale is carried on in a few isolated villages of certain States which comprise the Shan States. In the Myedo and Thayetmo Sub-divisions of the Thayetmyo District, a species of the silkworm known as "Bombyx Fortunatus" of both the white and yellow varieties is reared to an extent and the silk obtained from this worm has been pronounced to be of excellent quality. In the Shan States the breeding is done in a careless, perfunctory and slovenly manner, usually in the dwelling-room of the breeder, and in consequence the silk is naturally of a very inferior quality. The winding of the silk from the cocoon is equally carelessly done and the already bad thread is not improved thereby. With more careful supervision throughout each process, better feeding of the silkworms and greater attention and care in the liberation of the silk in reeling, a much better quality of thread would undoubtedly be obtained.

The more important of the species of worm obtained in Burma may be classified under two heads: (1) The domesticated or Mulberry feeding known as the "Bombyx Arracanensis" and the "B. Fortunatus and (ii) the wild or non-mulberry eating, feeding mostly on leaves of trees and plants growing in the jungle. This latter class is again subdivided into two species the "Circula Trifenestrata" and the "Attacus Atlas." The worms of all the Burma species are moltivoltine, *i. e.*, producing several crops of cocoons annually which, however, contain a comparatively small amount of silk. The thread is so loosely wound round the cocoons that it is almost impossible to prevent entanglement in the process of reeling. The silks of the "Circula Trifenstrata" are very handsome in appearance, but owing to the very irregular manner in which the insect lays the fibres of its cocoons and the quality of the gum, with which the silk is loaded all attempts to reel them have hitherto proved failures. They are in consequence, used in the manufacture of 'waste' or poss of a superior quality from

which silk of a very good quality may be spun. The threads are long, glossy and fine and with modern spinning, appliances, a great future awaits this silk. This species of the worm is reported to be very abundant in Burma and the cocoons are said to rot in the jungles for want of gathering.

The *Bombyx Arracanensis* have hitherto only been obtained from the Pauk Sub-Division of the Pakokku District, the species of the domesticated class elsewhere belonging to the tribe *Bombyx Fortunatus.*

The natural conditions most suitable to the silk worm—a mild equable climate, an atmosphere free from an excess of moisture or heat with abundance of pure fresh air—are to be met with in some of the Districts of Burma and a great portion of the Shan States would appear to satisfy these requirements, besides the mulberry grows profusely along the beds of sweet-water-streams and can be made to yield several crops of leaves in a year. There is, therefore, no hindrance to sericulture and with certain precautions, *viz.*, (i) protection of the worm from ants and flies, (ii) regular feeding, and: (iii) the isolation of the worms from the vicinity of tobacco and the annoyance of the smell of the trumpet fruit (*Bignonia Indica*) being cooked combined with improved methods in the different stages of the industry, sericulture may be turned into a most profitable occupation in the Province.

On the initiative of Sir Thomas Wardle, President of the British Silk Association of Great Britain and Ireland, the pioneer of the Silk Industry in Cashmere, the local authorities during 1903 and 1904 tried the experimental culture of the French silkworm "(Bombyx Mori)" an annual worker. What are technically known as seeds were procured from France and distributed to the chief centres of the silkworm industry in the Province including the Shan States; though the eggs hatched in several districts the worms were very short-lived and the experiment proved a lamentable failure. The cause is attributed to the eggs hatching, a couple of months before the new leaves in the trees began to appear, to the worms refusing the leaves and to the climate. These causes may have partly accounted for the failures but the true reason may be said to be the want of proper methods in the rearing of worms.

It is generally the impression that, if the French and possibly the Italian species of the silkworm are to be permanently cultivated in Burma, it would not be politic to do so without expert [illegible]

vision, and the need of a silk expert is greatly felt.

The Japanese method of sericulture and reeling has been tested at Bangalore (S. India) and so far the results have been very encouraging. The Japanese reeling machines are effective and simple of manipulation and silk of excellent quality has been reeled with the use of these machines. There is no reason to doubt the efficacy of the Japanese methods of sericulture and the Japanese reeling machines may with advantage be tried here. In view of the scope for the extension of sericulture, the Imperial Department of Agriculture would do well to go into the question thoroughly and also supply the great want of an expert.—"E. L. in Capital."

SHAWL-TRADE OF INDIA

Of the principal trades and industries in which India has an acknowledged superiority and unrivalled reputation, Shawl-trade is one. It is of ancient growth and of a long standing. *Pasham* or wool, is aid to have been known to the primitive Aryans who traded with the hilly countries of the North. The superiority of the woollen fabrics of Kashmir is found recorded in the *Mahabharat*, where it narrates that the "people of Kamboja (the northern Districts surrounding Kashmir) brought cloths and skins as tribute to the king of Indraprastha. The former were made of wool and embroidered with gold, being in fact, shawl and brocades."

The Shawl-trade seems not to have met with much expansion under the Hindus. The limited quantity in which the raw material has always been available, kept the trade within limited bounds. Wool has never been an abundant produce of India. Hence import of coarse and fine woollen cloths in ancient India as stated in the Periplus Shawls are not found so often mentioned in old Hindu writings as silks. The shawl-manufacture does not appear to have thrived properly till the time of Akbar, after the expansion of his sovereignty to the valley of Kashmir. It rapidly developed under the encouragement of that emperor, and attained the high position it now holds. The Ayeen Akberi has the following interesting account about shawl :—"His Majesty has ordered four kinds to be made: 1st—*Toos assel* (grey assel) which is the wool of an animal of this name whose natural colour in general, is grey, inclining to red though some are perfectly white and these shawls are incomparable for lightness, warmth and softness. Formerly, they were

made of the wool in its natural state, but His Majesty has had some of them dyed and it is surprising that they will not take red colour. 2nd—*sufid alcka* (white alcka) which they also call Terehar. The natural colours of the wool are white or black, and they weave three sorts, white, black and grey. Formerly, there were not above three or four different colours for shawls, but His Majesty has made them of various hues; 3rd —*zerhozy* and others which are of His Majesty's invention; 4th— From being short pieces, he had them made long enough for *Jamahs* (gown pieces). The shawls are classed according to the day, month, year, price, colour, and weight; and this manner of classing is commonly called *missel*. The *mushrifs*, after examination, mark the quality of each shawl upon a piece of paper affixed to its corner. All those brought into the palace on the day Ormuzd of the month Fedum (10th March) are preferred to those received afterwards, of the same fineness weight and colour and each is written down in order. Every day, there are received into store the following kinds, *Toos, Sufid Alcka, Lall Zurren, Gulab Pezgul* and thirty other kinds; and from this account of one day, may be formed an idea of what is done in the course of a year. Formerly, shawls were but rarely brought from Kashmir. By the attention of the Emperor Akbar shawl-manufacture in Kashmir is in a very flourishing state, and in Lahore there are upwards of a thousand manufactories of this commodity. They also make an imitation of shawl with the warp of silk and the woop of wool; and this is called *mayan*, of both kinds are made turbans.

The Improvements introduced by Akbar were kept up by his successors and shawls became a favourite article of dress in the Mogul period. They became the wearing apparel of every well-to-do man in the country and the fashion spread to Persia and Turkey. This increasing demand infused a great vigour into the trade which made it prosper despite all political disturbances occurring at times and supervening to retard all progress. During its subjection in the Mogul Dominion, Cashmere contained 40,000 shawl looms. *Mulk and Millut.*

KASHMIR SHAWL INDUSTRY

Dr. A. Mittra has really done a great service by the publication of his "Notes on the Arts and Industries of Kashmir," at a time when there are sincere attempts at revival everywhere and when the

Kashmir Durbar is so keen on the development of the industrial and natural resources of the State. In this welcome pamphlet Dr. Mittra devotes several pages to a discussion of the future of the shawl industry. Kashmir shawls have from remote ages, been world-famed and have for centuries enjoyed a high place in the ranks of European fashion ; but latterly the industry has shrunk and dwindled--first owing to the Franco-Prussian War in 1870, and then on account of the devastating famine of 1878-79. It is true that, Maharaja Ranbir Sing advanced as much as 10 lakhs to the shawl manufacturers with a view to reviving the industry which was, in a manner, extinguished by the famine ; but yet it has not been able to recover its lost position. Indeed, while in 1822, the whole value of shawl goods manufactured in Kashmir might be estimated at 35 lakhs of rupees per annum, now it is quite insignificant in comparison. The question now is—how to revive the art. There ought to be no great difficulty, for the workmen are there. Here is what Mr. N. G. Mukerjee wrote in 1901 :—"Now the question is, whether it is possible to revive the trade; and if so, how? That it is possible to give a new life again to this industry there can be no doubt ; inasmuch as the workmen, as a class, are not yet extinct. They can be collected together again with very little effort, as a slight promise of emolument will induce those scattered over India to flock back to their native land and betake themselves to their hereditary profession once more with renewed energy."

It is, however, not on extraneous help or foreign appreciation, as suggested by Mr. Mukerjee, that we should seek to re-build the industry. If Indians were to act up to the advice of Sir. George Bordwood, that "Indian gentlemen and ladies should make it a point of culture never to wear any clothing or ornament but of 'native' manufacture and strictly 'native design,' the future of the Kashmir shawl industry may yet be assured."

THE RUBBER OR THE FUTURE INDUSTRY OF THE WORLD*

One of the most valuable articles in the world is rubber, and its use is greatly increasing every day, and as a high commercial authority remarked some time ago, it is *the* future industry of the world.

* For other articles on Rubber, *vide* p.p. 96, 117-120 *ante*.

Up to very lately, the best rubber known in the world was the kind of rubber known as the Para rubber and it used to fetch the highest price in the market, but lately the highest price was obtained by the Ceylon rubber and the Para rubber has for the first time been beaten.

Reuter lately wired the most astonishing news that a certain London firm of brokers had purchased 6 tons of Ceylon rubber at such a high rate as 6s. a pound which is a record price and specially so for Ceylon rubber, when Para rubber which, up till now, was considered to be the best and costlest rubber in the world, was selling at 5·50s per pound at the highest.

But it is greatly regretable that the Rubber exported from India is occupying the same position as it used to do fifty years ago, this, notwithstanding the great improvement going on in every thing else. In strength and colour, it is not inferior to the best rubber in the world, but its uncleanliness is the principal thing objected to by the buyers and consequently it is sold nearly a shilling per pound less than the Para rubber.

RUBBER PLANTING AND PROFITS

Mr. Dacre T. Edwards writes as follows to the Editor of the "Financial News," refering to the rubber industry as one which promises to be a veritable gold mine to the planters engaged in it :—

"When tobacco-planting was first taken in hand by Englishmen in Borneo, they very naturally endeavoured te sell their produce in London, hoping to make that a centre for realisation. They very soon found out, however, that they were doing so only at a disastrous cost to themselves, and wisely realised that in business no sentiment should be allowed to exist, and that, as long as they got a good price, it was immaterial who paid it. The result is that now all British grown tobacco is realised in the Dutch markets. The same thing will undoubtedly take place in rubber. Great Britain as a market sinks into insignificance, when compared to Antwerp and New York, and the sooner planters in the Malay States and Ceylon realise this, the better it will be for them. It is the continental and American buying in Colombo and Singapur which accounts for the the prices realised there for rubber being so much above London parity. I believe I am correct in stating that practically the

whole of Straits and Ceylon rubber hitherto shipped to London has been bought for either American or Continental account. I have frequently heard men in Mincinlane say.—Why, should Straits and Ceylon rubber fetch a shilling a pound more than fine South American Para? The reply to this is simple; fine South American Para contains from 18 per cent. to 20 per cent. of impurities and shrinks to that extent when subjected to the necessary washing process. Cultivated Straits and Ceylon rubber is practically pure, in fact, the creeped rubber which is now being shipped is so pure that the expensive process of washing become, entirely unnccessary, and the cost of labour entailed by running the washing machinery, a very considerable item, is saved. On the Continent and America the economy of buying pure Straits and Ceylon rubber at 1s. a pound over the rates, runing for South America Para has been quickly realised, but in England it has apparently been entirely overlooked.

Great surprise has been evinced at the large premiums at which the shares of all the leading British rubber producing companies now stand, The reason is that, it is only now beginning to be realised that a quicker and much greater yield may be expected than was originally anticipated. However, one must remember that most of the companies formed so far have been brought out by firms of the highest standing, who have no doubt been anxious not to overstate the possibilities. For instance, instead of not being able to tap the trees until they are six years old, one knows that they can commence tapping at four years, and morever a tree ten years old will yield more later if the tapping commence at four years, than if it had been left untapped until six years old. Tapping trees at four years old does them good and increases their yield as time goes on. Again, a tree eight years of age instead of yielding from $1\frac{1}{2}$lb. or 2lbs. of rubber per annum, the amount which I understand has formed the basis of the probable returns foreshadowed in the prospectuses of the companies to which I have referred, will in all probability yield double that amount. Before concluding, I should like to sound a warning note. Notwithstanding the brilliant prospects of those companies which are operating in the Straits and Ceylon in cases where they are moderately capitalised and well-managed, and where the suitability of the soil and the price of labour has been carefully studied, it goes without saying, since the subject of rubber cultivation has been brought into such prominent notice that a lot of

companies will be issued operating in various parts of the world where the conditions necessary to success are non-existent.

THE INDIA RUBBER

India rubber is the juice of a Banyan-like tree growing wild all over India, but principally in Assam and in the damp forests at the base of the Himalayas. In India, the tree is known as the '*Bangshi Bot*' and is considered sacred by the Hindus as being one of the favourite trees of Sree Krishna who used to play on his flute under its cooling and capacious shade. Nearly in all respects, it resembles the Banyan tree and like it throws out numerous aerial roots which touching the ground become the trunks of others and thus gradually cover a very large area. Botanically it is known as the *Ficus Elastica*.

In its natural state, the India rubber, "Fig or Caoutchouc tree" to quote from an interesting article written by Mr. D. P. Copeland in 1899 "starts in the forks of other trees often 20 or 30 feet or even more from the ground, from seed contained in the droppings of birds that have fed on the rubber figs, where the seed germinates and the young plant remains an epiphyte for years until its aerial roots touch the grounds; as soon as this takes place, the little epiphyte changes rapidly into a vigorous tree throwing out numerous aerial roots which gradually envelop the tree on which it first began life and often kill it. Having started life so high up, it often throws out branches which overtop the surrounding trees and the numerous aerial roots which fall from these and establish connection with the ground in a few years, enable it to dominate the forest growth arround it"

The way these valuable trees are tapped and rubber collected is not all that could be desired.

The *junglies* cut the trees without any consideration to their age and at any place that suits them best. Then the juice that comes out of these cuts is generally allowed to run down the trees to the ground where it is allowed to remain for some time before it is gathered generally very much mixed with mud, dust and stones; in Ceylon, the trees are tapped in a triangular shape at a certain height scientifically fixed according to the age of the tree and the circumference of its trunk. Then a clean piece of tin-tube is fixed therein and a perfectly clean pot made either of porcelain or glass is placed at the other end of the tube, where the juice is gradually collected. Thus

the rubber obtained in Ceylon is very clean and of the quality and strength the buyers desire. All the above operations are conducted directly under competent European supervision, the colour of the rubber plays some part in valuation, reddish rubber being much more liked by the buyers than white, and fetches about 6*d.* to 9*d.* per pound more than the other.

Besides India, this most useful article is obtained in large quantities from South Africa, Ceylon, Mexico and French Guiena, &c., &c.

The first notice of India rubber on record was given nearly 500 years ago by Herrona who in the second voyage of Columbus observed that the inhabitants of Hayti played a game with balls made "out of the gum of a tree" and that the balls although large, were lighter and bounced better than the wind balls of bastille. Torguemada, however, seems to have been the first to mention by name the tree yielding it. In his *dela mon quia Indiana*,, published at Madrid in 1615, Tom ii Cap. XLIII, page 663, he says—"There is a tree which the Indians (Mexican) call Ulaquahni, and is held in great estimation.

If every precaution is taken to draw only pure rubber from only mature trees under proper expert supervision, there is no reason why Indian rubber also will not fetch the same high price as has been paid for the Ceylon rubber.

RUBBER INDUSTRY IN INDIA: OFFICIAL REPORT

The little of the industry that exists at present in India, is under Government control. The potentialities of this industry are great, and there is a vast scope for private enterprise and capital.

Of the rubber industry, as at present, being worked officially in India, a recent Government report records the following interesting facts. In Assam the Forest Department has nearly 3,000 acres under "*Ficus Elastica*" and tapping operations with over 5,600 trees yielded 9,283 lbs. of rubber giving an average of 27·5 lbs. per acre. In Bengal, there are 30 acres of "*Ficus Elastica*" being worked by the Forest Department whose experiments, however, with "*Hevea castilloa* and "*Kickxia*" trees have, however, been unproductive. It is intended to extend the Bengal plantation gradually to a total of 1,000 acres. In Madras experiments, at present on a small scale, are being made with various rubber-yielding species. In Burma "*Hevea brasi Minsis*" has done well in Tenasserim and over 1,500 acres have been

planted up mostly with *Hevea* and the prospects in respect to its cultivation are considered to be generally favourable. Of rubbers obtained from *Chonemorpha Macrophylea, Cryptostegia Grandiflora* and *Rhynchodia Wallichii*," the scientific and technical department of the Imperial Institute at Home has reported favourably on the two latters. The above particulars are of course only illustrative of the official experiments, and there is in addition a good deal of private enterprise concerned with the exploitation of product at the present time. In Southern India, at any rate, many planters have taken it up, and they will be helped there by the experience and teaching of the Government Curator of the Government gardens on the Nilgiris who has lately gone through a course of special study of the subject at Home under the direction of the Imperial Institute authorities.

ASSAM RUBBER

Its Commercial Prospects doubtful

[Dr. Mann's Emphatic Opinion.]

Dr. Harold H. Mann, scientific officer to the Indian Tea Association, contributes a very interesting article on the above subject to the *Agricultural Journal of India*. Dr. Mann expresses very strongly the opinion that, on present evidence, there is no commercial future for the Assam rubber industry except as a dependant of another and more profitable industry. We take the following extracts:—

The best rubber trees (Para and Castilloa) will not grow there (North and North-east India) or will only grow with difficulty and if they did grow, there is no security for their yielding a paying quantity of rubber; so that if these Districts had to depend on the introduction and acclimatisation of these trees, it is probable that they would never grow rubber at all. But there is a tree of which this part of India is the natural home, and whose product originally gave the name of 'India rubber' to the commercial article. This is the Assam rubber or *Ficus Elatoca*. This tree, however, possesses grave disadvantages ever the others named. It grows more slowly; when grown, its habit makes it more difficult to work; very much fewer trees can be planted on the same area; the rubber it produces is inferior to that from Para or Castilloa trees. In spite of all these disadvantages, there seems a possibility of fair returns being obtained by its culture under suitable conditions, and such returns have already been obtained in Java in the

Malay States, and in a sense on the rubber plantations belonging to the Indian Forest Department in Assam.

Dr. Mann discusses two recent pamphlets. The second of these, "*Ficus Elastica*: its natural growth and artificial propagation," by E. M. Coventry, Deputy Conservator of Forests, is an official publication of the Forest Department of India and contains a summary of the experiments made and the results obtained at the Government rubber plantations in Assam.

Capital Cost

The initial or capital cost of a rubber plantation cannot be judged, from the experience on the Government plantations, seeing their essentially experimental character. The actual amount expended on them, however, appears to have been Rs. 72 per acre (Bald), and this takes no account of the rent of the land or interest on capital both of which factors, must of course, be considered in any estimate of capital charges. Mr. Bald estimates this cost (again excluding rent, interest and expense of management) at Rs. 50 per acre. The cost of preparing the land is placed by Mr. Eardley Wilmot at a maximum of Rs. 20 to Rs. 30 per acre, if forest land be used. This, later part of the Tezpur plantings, is said by Mr. Bald to have cost Rs. 35 per acre up to date, or deducting Rs. 10 for plants, the cost of preparation and maintenance, up to the present, would for this area be about Rs. 25. Mr. Bald himself places the cost of preparing the land, obtaining the plants and tending the plantation till in bearing at eleven or twelve years old, at Rs. 50 per acre, which may perhaps be taken as a fair allowance under the most favourable conditions. If the time of yielding is delayed, naturally the cost will be greater,

If seed lines be used and planted 16 to 20 to the acre, Mr. Eardly Wilmot places the cost of plants ten feet high at Rs. 20 per acre—undoubtedly a very high estimate. There seems, too, almost a consensus of opinion that more plants than this should be put in an acre. Mr. Bald recommends 35 feet apart triangularly, or 41 plants to the acre. Mr. Eardley Wilmot is inclined towards close planting than has been customary at Tezpur, and one new plantation at least has been tried where the plants are only 20 feet apart. The whole question is very uncertain for the Tezpur experience and this alone, has rather told in favour of wide planting.

Maintenance and Yield

Thus planted out in the fashion approved by our authors, and

excluding cost, management and supervision, the expenses of bringing a plantation into bearing would be approximately as follows:—

	Rs
Rent of land under 30 year's lease for fourteen years ...	7
Cost of preparing, planting and maintaining till in bearing (14 years), labour being always available	56
Cost of plants	20
Interest on Rs. 83 for, say, ten years at 6 per cent. . .	50

Thus we have a total of Rs. 133 without considering the cost of management and direction at all. It is evident, therefore, that Mr. Bald's estimate of Rs. 150 in all is not above the mark, but probably considerably below it, unless such a rubber plantation can be run in connection with an existing tea or other estate.

It will be seen, however, that the whole of the above argument is affected in the most serious manner by the doubt as to the length of time required to bring the plantation into bearing. We have calculated on fourteen years, but the Government plantations were only tapped at twenty-five years old.

The question of yield, most vital as it is, seems to be the most doubtful in connection with the Assam rubber plant. A thorough, careful, close investigation is emphatically needed as to the best methods of tapping and the resulting yields. The present tools used, though a great advance on the older method of cutting with a *daa* are clumsy and unsatisfactory indeed. The method of allowing the rubber to congeal on the cuts is also very unsatisfactory.

Altogether we may say that if the present Tezpur yield only is obtained, the culture of *Ficus Elastica* is not and cannot be made a commercial success; there are strong grounds, however, for believing in view of results in Java and the Malay States that with an improved system of tapping much larger yields can be obtained, even three or four times the present amount.

Poor value of the product

We have now to consider the value present and prospective, of the rubber produced from the *Ficus Elastica.* It is well-known that it has never approached the value of the best Para, and according to the most reliable information, it is not likely to do so for the simple reason that it is not nearly so pure.

On the market, Assam rubber always obtains a lower price than Para, generally about from 6*d.* to 1s. per lb. less. Being an inferior article, it must be remembered that supposing in the future, the supply overtakes the demand, the poorer rubber will be the first to suffer.

What then is the result of our discussion? The first feeling on

rising from a perusal of the pamphlets is one of disappointment. The prospects are so doubtful and even if successful, so poor as compared with the culture of Para or Castilloa rubber in Ceylon, the Malay States, or even South India, that one is inclined to consider any large extension of the culture of *Ficus Elastica* in North-east India as out of the question. And I must say that this impression has been very strongly confirmed by almost all that I have seen in these Districts, if the Assam rubber is to be cultivated as a separate industry.

But as it stands, and with the data before us in the two pamphlets under review, I feel that no other conclusion is possible than that Assam rubber culture can only continue as a dependent of another larger and more profitable industry, and then can only occupy the inferior land.

DITTO IN ASSAM

The Government of Assam deserve the thanks of the public for its laudable enterprise to improve the rubber industry of the province. The *Ficus Elastica*, a tree, like the banyan, has long been tapped in the forests at the base of the Himalayas by the natives but the absence of scientific methods of production as well as the long time that a *Ficus Elastica* takes in growing to the condition to produce the necessary sap (about 20 years) have not attracted many people to this industry yet. Let us hope that the experiments carried at Charduar plantation near Tezpur will be the beginning of a very flourishing industry in India.

The financial results of the working of the Government plantations are recorded as below in the Administration Report of the Assam Forests for the year 1904-05:—

The capital cost of the Charduar and Bamuni hill plantation in Darrang at the close of the year was Rs. 2,19,400. The total outturn amounted to 9,818 lbs. realising Rs. 26,385. The cost of maintenance and establishment is quoted at Rs. 6,133, but this does not include the cost of harvesting and tapping (Rs. 4,197). The net receipts work out to a profit of 7.3 per cent. on capital expenditure. The capital cost of the smaller Kulsi reserve in Kamrup was Rs. 10,538. The outturn of rubber was 2,550 lbs., of which 1,488 lbs. were sold before the close of the year for Rs. 4,020, at Rs. 2-11-3 per lb. The value of the year's supply at this rate is Rs. 6,893, and as the expenditure incurred amounted to Rs. 676, the year's operations show a profit of nearly 59 per cent. The total outturn from

both plantations, 12,368 lbs., showed a satisfactory increase of 2,981 lbs., as compared with the year 1903-1904. The rubber obtained from forests in Assam, other than from the Government plantations, increased from 351 maunds, to 696 maunds, and the imports across the frontier from 2,767 maunds to 3,912 maunds. Duty on home and foreign rubber rose from Rs. 33,822 to Rs. 78,216. In the Lakhimpur Division an experiment was made in planting, cuttings of the Rhyncodia climber, which promises to be successful.

The Assam trade in rubber at the present moment is the monopoly of a band of ever enterprising *Marwaris.*

RUBBER CULTIVATION IN BURMA

OFFICIAL REPORT

Mr. H. M. S. Mathews, Revenue Secretary to the Government of Burma, has addressed the following letter, dated the 15th June, 1904, to the Government of India:—"I am directed to submit the following brief account of what has hitherto been done in this province in the way of rubber cultivation, what it is proposed to do and what the prospects of rubber cultivation now are. The Government of India gave their approval to a proposal to start a rubber plantation of 10,000 acres in the Tenasserim Circle, and sanctioned the expenditure of Rs. 2,10,000 to be spread over a period of 12 years. The object of this scheme was to prove that rubber plantations, especially in Tenaserism, would be successful, in order that, when this had been demonstrated, private persons might be induced to take up the cultivation of rubber. (?) Two areas of about 5,000 acres each were accordingly set apart near the town of Mergui in localities, where the soil and climatic conditions were believed to be favourable for rubber, one in the Sandawut reserve and the other on King Island. Work on the Sandawut plantation has proceeded steadily since that date on the general lines laid down by the late Inspector-General of Forests; and I am to submit, for the information of the Government of India, a letter from the Conservator giving a short history of this plantation up to the present date. The total area in this plantation now planted up with rubber trees 1,518 acres, and there is a sufficient supply of growing plants to carry on the work at the same rate of progress. The reservation of a tract of land intended for rubber cultivation on King Island was only notified in April last, and no planting has yet been done in this area. In

October 1899, Major Wyllie, Cantonment Magistrate of Rangoon, planted out some young "Hevia" trees, which had been grown from seed in the Cantonment Garden, Rangoon. These formed the nucleus of a small plantation which was managed for about three years by Major Wyllie and his successor with some assistance from Forest Funds. About Rs. 5,030 were spent on his plantation by the Forest Department up to the end of 1903, in addition to the expenses paid from Cantonment Funds, and some thousands of "Hevia" trees were raised. A careful examination of this plantation was made at the beginning of 1903 by the Forest Department and it was then reported that the experiment was practically a failure. The trees were sickly and stunted, and it was extremely doubtful whether the cultivation of "Hevia" in this plantation would ever pay expenses.

"*Hevia Brazillensis*" have been found to thrive in the Bhamo District, and small quantities of seed have been sent to Katha and Myitkyina for further trial. A number of experiments in the collection of latex from indigenous creepers have been carried out during last year or two. The reports on experiments with "*Chavannesia Esculenta*" and "*Patameria Creepers*" and also with "*Rhynchodia Wallichii*" are not conclusive. As regards the measures which His Honour the Lieutenant-Governor proposes to undertake in future, I am to say that the work in the Mergui plantation will be carried on both in the Sandawut reserve on King Island as heretofore. His Honour considers that this experiment should be continued on an adequate scale, and for a sufficient time to prove beyond all dispute the financial success of rubber cultivation, at all events in Tenasserim. This result, of course, cannot be attained until at least a fair proportion of trees have reached maturity, and if it is achieved, it may be found profitable, if desired to leave the plantation to a private company. The Conservator points out that an extension of the plantation has led to a considerable increase in the work and endeavours will be made to post an officer of the Provincial Forest Service as Assistant Manager as soon as possible. Further experiments with various creepers have also been ordered in the Pegu and Tenasserim Circles, and the results will be communicated in due course to the Government of India. The cultivation of both "Hevia" and of rubber yielding creepers in the northern division —Bhamo, Katha and Myitkyina— will continue to receive attention, and further enquiries will be made into the cost of cultivation

and of the collection of latax and the value of the resultant rubber. as regards the future prospect, the Lieutenant-Governor agrees with the Conservator in considering them to be generally favourable in respect to cultivation of "Hevia." Much, indeed remains to be learnt about the best method of collecting latex, preparing the rubber and many other details, but there seems no reason to doubt that with care the rubber of excellent quality can be turned out which will command a remunerative prices. Some enquiries have been made by private individuals with a view to the undertaking of the cultivation of the rubber plants under European supervision, but up to present nothing has come of these. A plantation of over 1?,000 acres of "Hevia" has been founded at Bhamo which is doing well, but no return can be expected for some years. New rules are under consideration for amending the rules under the Lower Burma Land and Revenue Act, so as to facilitate the allotment by grant share of large areas suitable for rubber cultivation.

RUBBER-PRODUCING PLANTS IN BURMA

Little is known about the great majority of the numerous rubber-producing plants which exist throughout Burma, and with the present day enormous consumption of rubber for various purposes, the recent action of the Burma Government in causing enquiries to be made into the qualities of some of the known rubber-producing plants is very opportune.

Attention has been confined principally for the present to *Parameria glandulifera* and *Chavanasia esculenta*, two creepers which, besides having been tried in plantations, are of common occurrence in the hills and most lands which stand above flood level. It is reported that the extension of cultivation and of *taungya* clearings has reduced the area, over which they are to be found, but there must still be extensive tracts on which those two species abound.

The enquiry originally aimed at ascertaining the market possibilities of these two rubbers, but at first the object of the enquiry was lost sight of, and the experiments were carried out on too small a scale to be of much practical value in supplying data for the cost of collection, preparation and freight. Unless these be favourable, the best rubber in the world may have no commercial value.

* From correspondence communicated to the Editor by the Government of India

Experiments carried out with the latices of the two rubbers show that coagulation takes place naturally in both cases in about 48 hours. The addition of small amounts (15 drops) of creosote and acetic acid had no effect in either case in expediting coagulation. A small pinch of alum added to the latex resulted in instantaneous coagulation in both cases.

Specimens of both rubbers were sent to the Reporter on Economic Products to the Government of India, who gave his opinion that judging from the specimens received good rubber could be got in many ways from both species. Fresh samples have been sent to the Imperial Institute for analysis in order to ascertain the percentage of resin in the latices—an important point; with this information and a knowledge of the cost of preparation and freight and the supply available, the Department should shortly be able to say what are the possibilities of those two rubber species in Burma.

What is believed to be an important discovery in connection with the production of rubber has been made by Mr. Stearsey, Extra Assistant Conservator of Forests. He has reported that the creeper *Rhynchodia Wallichii*, *Bentham*, which abounds on lands submerged to a depth of 10 or 12 feet during floods, yields a good rubber. He has forwarded some samples of the rubber, which are described as excellent; samples have been sent to the Imperial Institute for analysis and valuation.—*Indian Forester.*

REPORT ON THE RUBBER OF RHYNCHODIA WALLICHII FROM BURMA

By Professor Wyndhan R. Dunstan, M.A., F.R.S, Director.

This sample of rubber. Register No. 19779, prepared from *Rhynchodia Wallichii* in Sheweg-yin, Tenasserim. Burma, was forwarded to the Imperial Institute for chemical examination and commercial valuation by the Reporter on Economic Products and is referred to in Letters No. 2721-32 F.S. of the 26th August 1903, and No. 154-32 F.S. of the 18th January 1904.

Several notices have recently appeared regarding the rubber-yielding properties of this plant, which is reported to be fairly common in the Pegu Division, and the rubber obtained from it has been described as of good quality.

The sample received for examination, consists of an irregular cake, weighing 48 grams, which was slightly mouldy on the surface. The rubber was dark-brown throughout and contained a small amount of vegetable matter. Its physical properties were very

satisfactory, it being quite free from stickiness and exhibiting good elasticity and tenacity.

The rubber had the following composition:—

	Sample as received, per cent.	Calculated for dry material, per cent.
Moisture ...	2·8	...
Caoutchouc	86·5	89·0
Resin	6·5	6·7
Dirt	4·2	4·3
Ash included in dirt	0·48	0·51

These results show that this specimen of the rubber of *Rhynchodia Wallichii* is of good quality, as the dry material contains 89 per cent. of true caoutchouc and only 6·7 per cent. of resin. It may be noted that a small amount, about 1·5 per cent. of the caoutchouc was insoluble in the usual solvents.

The rubber was submitted to brokers for commercial valuation, and they report that at the present time consignments of similar quality would sell readily in the London market at about 3s. 6d. per lb. This valuation, it must be noted, is based upon the high prices which are at present ruling in the rubber market, Para rubber being 4s. 8d. per lb. on the day upon which the valuation was obtained, so that the price mentioned will represent rather more than the normal value of the rubber. There is no doubt, however, that the rubber of *Rhynchodia Wallichii*, if of similar quality to the present sample, would always sell readily and command a good price in the market. The plant is reported to be common in certain districts of Burma, and it, therefore, appears, to be worthy of attention as a possible source of rubber.—WYNDHAM R. DUNSTAN, Imperial Institute, London, 20th May 1904.

CEYLON SOIL AND RUBBER

A planter who has spent several years in the Solomon Islands, and just returned to Ceylon, gives as his opinion that rubber would do very well there. The rainfall was abundant: "It rains nine months of the year, and then the rainy season begins," he remarked: "Ceylon rubber seed has been imported and the young plants promised well. The soil there is exceedingly good and fertile, and of very great depth."

"You go down through soil to a depth of 18 to 20 feet before you reach the soaptone or coral rock." Messrs. Lever Bros. intend planting rubber wherever the land is unsuited for cocoanuts, especially where it is inclined to be swampy. The opinion was, that rubber will be "the finest thing out."

LANDOLPHIA RUBBER IN CEYLON

Imported Plants from Brussels

Among the many enterprising planters of Ceylon, who take an interest in rubber-producing trees, few appear to have been so ready to take up other varieties than Para and Castilloa as Mr. Van Der Poorten, J. P., the proprietory planter of Greenwood, Galagedera.

Mr. Van Der Poorten has had over 20 years' experience with rubber trees, not only in Ceylon, but also in Africa, where he was a Dutch Government servant in the Congo State and learnt much concerning the various Landolphias which provide the bulk of the African rubber. Indeed, but little was done in Congo rubber when Mr. Van Der Poorten was first engaged there, and he helped the Government considerably in their initial enterprise and in planting imported plants from Brussels.

While at home recently, he visited the Royal Gardens in Brussels, where he is well-known to the officials. Presumably, the topic of Ceylon rubber came up and Mr. Van Der Poorten's planting work out here, for he was offered a consignment of some 1,500 cuttings of Landolphias. Such a large stock, says Mr. Van Der Poorten, was useless to him; but he willingly accepted a Wardian case full. These were in three varieties. *Landolphia owariensis*, *L. Klainii* and *Clitandia arnoldiana*, and 101 plants in all. The cuttings were well-rooted, and just lifted out of the pots and packed in the case; he saw to their proper packing himself and the plants arrived in excellent condition and are doing well. There is no doubt, he says, that the Landolphia species will do well in Ceylon, as the soil is quite as good as what they get in Congoland; of course they require forest shade.

Mr. Van Der Poorten is planting them, he says, at the foot of forest trees in jungle on his estate. The undergrowth is cleared away, and the vines will be trained round the trees and require very little attention or cultivation.

Rubber merchants and manufacturers in Europe have told Mr. Van Der Poorten that the Landolphia rubber is of excellent quality. It is very elastic and springy and would procure good prices. Of course, says Mr. Van Der Poorten, the Landolphia rubber from the Congo, fetches low prices because it is collected and cured by natives only and is sent in a very dirty, bad condition: if trouble were taken with it as with Coylon Para rubber, it would fetch a very fine price.

Mr. Van Der Poorten has Para and Castilloa on his estates, and will start tapping the latter before long. When rubber was boomed in Ceylon some years ago, he went in for Ceara rubber *(Manihot Glaziovii)*; but on leaving for home lately he abondoned it. He has some few trees of *Funtumia elastica*, which he is experimentally tapping. There are also on the estate a few specimens of another rubber tree which he planted many years ago, but also abandoned. These, he is now looking after again as they are full of latex and give a capital rubber. Mr. Van Der Poorten has quite forgotten the name of the tree, and specimens sent to Peradeniya and Buitenzorg Botanical Gardens, could not be identified.

Mr. Van Der Poorten hopes to go to Java in two or three months, and will take specimens of this tree with him to Buitenzorg in the hope of having them identified there.

As his three lots of Landolphias are all labelled, he hopes that by comparison the Director of Peradeniya may be able to identify "root rubber" which we recently announced, had been received at the Gardens from Mr. Thomas Christy, London. Root rubber in the Congo, says Mr. Van Der Poorten, is obtained from a Landolphia, but it is one with a modified growth; prevented from growing as a creeper by the annual bush fires it has developed underground stems or rhizomes, and from these the rubber is obtained.—*Ceylon Observer*.

CULTIVATION OF THE CEARA RUBBER IN MYSORE

From the commencement, the Ceara Rubber tree took kindly to the climate of Mysore. At first the seeds took a long time to germinate owing to the hard and resistant nature of the outer integument. But a remedy was soon found to this in slightly filing the dormant end of the seed, so as to expose the vitaltissues to the action of warmth and moisture. Treated in this way, seeds germinated freely within a month. Self-sown seeds, when well-placed, usually germinate towards the end of the first monsoon. But when the conditions are unfavourable, the seed will often lie "*in situ*" for years. The best results of self-sowing are nearly always found in grass land, especially when the grass is pretty thick. In the moist coffee districts the tree grows rapidly and attains a large size in 4—6 years, it also remains longer in leaf than it does on the plains.

Maidan growth is more stunted, and the leciduous season often extends from January till June.

It has been proved, which is equally important, that the rubber is of good quality, the London Brokers of an Indian firm having estimated its value at 3 shillings per pound. Added to this, the remarkable discovery has been made that a single tree will yield 7lbs. of rubber during the year without being in the slightest exhausted. The tree thus operated upon is 15 or 16 years old. It was tapped 83 times during the year and gave the above outturn of solid rubber. To hear that a tree is worth a guinea a year is certainly most encouraging, and if the average result in working a large plantation amounted to half or even the quarter of that amount it would still be a good industry.

Without going into fuller detail, our tapping experiments have been the means of pretty clearly establishing the following conclusions:—

1. That at 15 years of age and upwards every woody part (including the root-limbs) is well charged with latex.

2. That trees are not equally productive of latex though all conditions appear to be the same. At the present stage of the experiment, there are good and bad trees.

3. That the root-limbs are productive of latex when the trunk is nearly exausted, and *vice versa*.

4. That the latex flows freely from 6 to 8 A.M.

5. That excepting in wet weather, trees may be safely tapped at short intervals all the year round. Once a week would give a good average return of rubber.

6. That crude methods of tapping are wasteful, and require to be replaced by an improved method having proper tools and implements.

When a healthy tree has attained 15 years of age it may be tapped. Such trees are usually of considerable girth, having a trunk nearly 4 feet in circumference at the base with a clean growth of 7 to 12 feet to the primary limbs or branches. The whole trunk may be tapped at intervals, though it is found inconvenient to operate much above a man's height from the ground. The best season for tapping the trunk is from July to January while the trees are in leaf. When trees are about to be tapped the outer dead bark should be removed, leaving the surface of the liber (inner bark) as smooth and clean as possible. At this stage sponging or washing with lime juice or salt water has been recommended. In any case, the latex should flow over a perfectly clean surface until it is deposited in equally clean receptacles placed

around the base of the trunk, or suspended to the latter at points where the streamlets of milky juice can readily be intercepted. A very small quantity of clean water placed in each receptacle prevents coagulation, so that each day's collection of latex can be placed in a churn for the proper extraction of pure rubber.

The laticiferous vessels of this tree are situated in the liber or inner bark, which is usually of a greenish colour when first exposed to the light. It is a comparatively thin layer and the slightest puncture with a pin suffices to draw latex. Tapping the bark deeply, or slashing and scoring it obliquely to swell a central stream, fails to produce the best flow of latex while it undoubtedly injures the tree.

But when punctured and scored to the depth of $\frac{1}{6}$ of an inch, in the early morning, the flow is usually well sustained for a couple of hours.—"MYSORE STANDARD."

THE MADRAS FOREST DEPARTMENT EXPERIMENTS WITH RUBBER

The following is from Mr. C. E. Brasier's Report on Forest Administration in Madras for the year ending the 30th June, 1905:—

Rubber trees—(*a*) *Landolphia florida*—The 22 trees in South Malabar mentioned in last Report are in good condition though somewhat damaged by monkeys.

(*b*) Ceara—(*Manihot glaziovii*).—The plants in Chatrapur, Ganjam, exist without thriving. A single tree, apparently remnant of an abandoned rubber plantation on Kondapalli hill, Kistna, has reproduced about 50 plants, all of which are doing well, the climate and other local circumstances of Kondapalli evidently suiting the species. Those put down in Someshwar, South Canara, did not germinate, but 4 out of 300 seedlings planted near Alur rest house, were 9 inches high and in good condition. Seeds sown in Kanoth in North Malabar did not germinate. In North Malabar 2 acres in Kanoth reserve, contain well established and large trees, which have been tapped once without results being recorded however. There is another plantation at Manantoddy which has similarly been tapped. The trees in South Malabar diminished in number, some being blown by wind, while their natural reproduction was considerably checked by deer and sambhur. None of the 1304 seeds (Kallar variety) sown in the nursery last year germinated. In

the Nilgiris, there are 16 well-grown trees in and around Benne nursery and growth from their seed is abundant. Three thousand five hundred and fourteen seedlings were planted in Benne Teak Plantations and Station and Mudumalai, but none of the seeds sown in the nursery germinated, An attempt was once more made to introduce the species in North Coimbatore, but was a failure, only two meagre seedlings surviving in the Range Compound at Satyamangalam. The Ceara rubber trees planted at Mount Stuart in South Coimbatore are well established and are bearing seed; natural reproduction from seed is also prevalent. Sowings of this tree at Kodaikanal, Madura proved a failure. A small percentage of seeds sown in Tinnevelly, germinated. There is a fine specimen of the tree 12in. high.

(c) *Ficus Elastica*—The young plants put out in various places in Ganjam did well where sheltered from the sea coast wind and sand blow, but died elsewhere. In Nellore, the experiment proved a failure in Kollurpad plantation.

(d) *Heavea Braziliensis* (Para rubber).—Seeds failed to germinate in South Arcot. Three hundred and twenty plants survive in the nurseries at Someshwar in South Canara and are being transplanted. Of 535 seeds sown in Begur, North Malabar, 15 germinated and only 3 now survive. In South Malabar, 24 trees exist in Iravillicava in good condition. Of the 535 seeds sown, 64 germinated, but owing to the damage done by rats, monkeys and porcupines, only 8 plants survived.

(e) *Kickxia Africana.*—Only 22 of this exist in South Malabar. They show very shrub by growth and are not likely to produce much latex. They were much damaged by a boring caterpillar.

(f) *Dichopsis Elliptica.*—One hundred and fifteen lbs. of rubber were manufactured from the milk of this plant in South Coimbatore at a cost of Rs. 100 and sent to Messrs. Peirce Leslie and Co., at whose instance the experiment was undertaken.

RUBBER PLANTATION SUCCESSFUL IN TRAVANCORE

Mr. S. Imray, a well-known planter on the Travancore Hills, had taken up 4,000 acres for the cultivation of rubber. This venture having proved successful, he is going to extend the industry by planting another patch of land near Konni, Central Travancore, with rubber.

PLANTATION OF RUBBER IN THE BOMBAY PRESIDENCY

Experiments in rubber cultivation are also in progress in the Bombay Presidency under the direction of the Government Economic Botanist, the varieties under trial at Ganeshkhind being *Ceara*, *Cryptostegia Grandiflora*, *Heavea Braziliensis*, *Castilloa Elastica* and *Kickxia Africana*. The *Ceara* variety it appears, gives promise of adapting itself to the climate of the Deccan and also thrives well in the Konkan. The *Cryptostegia* variety is said to be common in parts of the presidency, and as it grows luxuriantly and spreads itself quickly, it is believed that it might become a valuable adjunct to the resources of Deccan and Konkan villages. A recent analysis of the rubber pronounced a sample to contain 83·4 per cent. of caoutchouc. The *Heavea* and *Castiloa* varieties introduced from Ootacamund are, however, not promising, though *Kickxia* also introduced from the Nilgiris is doing satisfactorily. As a commercial industry, it seems doubtful if rubber cultivation will "catch on" in the Bombay Presidency, where cotton, sugarcane, tobacco and ground-nut already monopolize the field. We have already referred recently in these columns to the great possibilities of sugarcane and tobacco as affording excellent investments for capital in the Western Presidency, provided existing methods of cultivation, etc., are improved upon.

The following Press Note was issued by the Government of Bombay:—"At the Industrial and Agricultural Exhibition held at Bombay, Colonel Wyllie of Belgaum exhibited certain specimens of rubber grown within the Cantonment. Mr. Ryan in charge of Forest Section of the Exhibition suggested that, in view of the great demand for rubber, some steps ought to be adopted to introduce rubber plantations experimentally in the Southern circle, adding that experiments were being made in the nursery in Thana. Conservators of forests were consulted and on a consideration of the reports and of a Resolution passed at a recent Agricultural Conference, Government have decided that arrangements should be made for starting experiments in the cultivation of rubber plants both in the southern and northern circles and in the Garden of Economic Botany about to be established in Bassein. For the northern circle, Mr. Ryan is requested to prepare and submit, under the direction of the Conservator, a scheme for the plantation of *ficus elastica*, and to make experiments to ascertain the yield of rubber and its commercial value, and to suggest other rubber

plants which he may consider *likely* to show *good* results. For the. Bassein Garden, Mr. Ganmil has been asked to prepare a scheme of experiment on a smaller scale in numerous rubber-yielding plants, with the object of ascertaining which is most likely to succeed in the Coast Districts of this Presidency. For the southern circle, orders have been given for the preparation of a scheme for experimental plantation more particularly *heavea* in one or more localities under the direction of the Conservator by the officers best fitted for the purpose. It has been directed that full information should be obtained of similar work, which is being done in Ceylon, Burma, Tennesrrim; and schemes of experiment should be prepared with due regard to economy, beginning on a comparatively small scale with the provision for expansion. Plantations in Kanara will be most extensive and will be under the supervision of Forest Officers best qualified for the work.

BOMBAY GOVERNMENT'S EXPERIMENTS

Bombay, August 3, 1906. A correspondence has been officially published regarding the Bombay Government's proposal to grow rubber. The Conservator of the southern circle writes:—"As regards the probabilities of success, I confess to being very sceptical. The conditions in Kanara are quite unlike those obtaining in other countries, where the plant actually thrives or where it is still under experiment. I understand that the Government plantations at Mergui have not so far been particularly successful, though good results are still hoped for. It is, I think, very doubtful whether success can be attained in Kanara without recourse to irrigation, which will add very materially to expenditure." The Government Resolution says that it appears from Mr. Copleston's report that the prospects of rubber succeeding in Kanara are not very hopeful, for although the temperature is ideal from the point of view of rubber, the rainfall is too unevenly distributed over the year for Para which appears to be the rubber, most worth cultivating. Mr. Copleston seems to have made a very practical inquiry into his subject while in Ceylon and his advice to start with three small plantations of *Para*, *Castilloa* and *Ceara*, of about 20 acres each, should be acted upon. It is of course possible that *Castilloa* and *Ceara* may turn out to be suitable and remunerative in Kanara.

GROWTH OF THE RUBBER TRADE

AN IMPORTANT NOTE

The following is from the "Times Financial and Commercial Supplement":

During the last five years, there has been an enormous expansion in the commercial demand for India-rubber, and the price of this once insignificant commodity has doubled during that period. Best Para rubber was dealt in last year at as much as 5s. 9*d.* a lb., and since the opening of 1906, the market quotations have ranged from 5s. 3½*d.* to 5s. 5*d.* To the motor and cycle industries, rubber is indispensable, and the demand from these sources constantly grows. It is almost as vital to the electrical industries, and there are, indeed, few trades in which some quantity is not a necessity. No efficient substitute has been discovered for this strange vegetable product, though an immense fortune awaits the man who can light upon one. So obvious and apparently permanent a demand as that for India-rubber has caused much attention to be devoted to the increase of supplies. Prospectuses of rubber-producing companies have been courting public favour at more or less regular intervals for months past, and there appears to be no doubt that, the scientific cultivation of rubber-trees will in time produce a supply which can more than keep step with that derived from the native forests of South America.

NATIVE AND ARTIFICIAL SUPPLIES

The chief sources of rubber-production, South America depends entirely upon indigenous trees mainly in the delta of the Amazon river. There have not at any time been intelligent efforts to improve these because the natural supplies have hitherto been amply remunerative. Nor have any changes been made in the crude methods of procuring and curing rubber. The treatment of the trees has been, and still is, of a barbarous and destructive character, and the subsequent processes of the crudest nature. The wasteful methods of rubber gatherers have forced them year after year to go further afield for rubber, with the inevitable increased costs in gathering and with no compensating economies in other directions. An industry conducted under such conditions can only be profitable so long as market prices advance beyond the increase in the expenses. As the prices of rubber have advanced something like 100 per cent. in the last five years, and as they are, in the case of Brazilian-rubber at least, returning extraordinary profits, the forests of the

Amazon are being more deeply penetrated and capital is being attracted there to conduct the rubber industry on modern methods and to improve transportation facilities. The South American Governments are also bestirring themselves, as in the matter of the agreement between Brazil and Bolivia for the construction of a railway to open up Acre, with 80,000 square miles of what are believed to be valuable rubber lands. By the terms of this agreement Brazil is to pay Bolivia £2,000,000, the whole of which is to be devoted to the construction of the railroad, the management and profits to be jointly shared. Brazil has already paid £1,000,000, and this source of supply, hitherto but lightly touched, may be freely tapped in the near future. The production of rubber last year amounted to, according to general estimates, 65,000 tons, and the exports from Brazil to 34,000 tons, or more than 50 per cent. of the entire production. In 1900, the total output was reckoned at about 50,000 tons, and in the same year the Brazilian exports were 26,700 tons, so that contributions from the latter source have fairly kept pace with the increase yielded from all other sources. Good authorities believe that during the present year the Brazilian output, in spite of the greater general difficulties in the way of collecting, will show a further increase under the stimulus of high prices. Congo exports in 1905 were 4,500 tons, but no increase in this production is likely for several years, as the Government has recently made severe regulations to stop the wasteful methods of collection; they also now insist on systematic replantation.

Ceylon and the Malay Peninsula

So far as efforts in the direction of intelligent cultivation of rubber, are concerned those in Ceylon and the Malay Peninsula easily take the lead and have reached an importance which may, in the course of two or three years, settle the question as to which can best meet the market conditions—cultivated rubber, which has to bear the cost of its cultivation, or wild rubber, which is burdened by the costs of gathering. The cultivation of rubber in Ceylon dates back some 30 years, when a great disaster to the coffee crop forced planters to turn their attention to other products. But it is only within the past five or six years that there has been a marked endeavour to extend it, and the flotation of rubber companies with that object in view, has been a feature of financial and commercial enterprise. Tea estates have also been largely interplanted with rubber. According-

ing to a compilation by Messrs. Gow, Wilson, and Stanton (Limited), there are now some twenty companies interested in, or devoted solely to, rubber cultivation in Ceylon with an issued capital of £1,349,030, ordinary shares, £472,270 preferred shares, and £290,000 debentures, And in the Malay Peninsula, fifteen companies with an issued capital of £548,520, ordinary shares £16,000, preferred shares and £5,000 debentures. The area planted by these companies is reported to be about 45,000 acres in Ceylon, and 50,000 acres in Malaya. A large proportion of the trees in both countries has not yet reached the yielding stage.

The outlook

Writing on July 16 last, our Colombo Correspondent dealt very fully with the prospects in Ceylon ("Financial and Commercial Supplement," August 21, 1905), and gave the total area in the world under cultivated rubber in 1905 at 149,950 acres. These figures were probably too small, as the area is increasing faster than observers can keep pace with it. The chief points to be borne in mind by investors who may be attracted by speculative rubber producing companies, is that the present price of rubber is due to exceptional conditions. A comparatively small part of the area under cultivated rubber trees has reached the stage of production—the trees are non-productive until they are from four to seven years old, according to the variety—and that the producing stage will be reached by an enormous and increasing quantity of trees during the next three or four years. The expansion in the supply will, too, mainly be in the choicest rubber, which is at present highest in price, but which will be first to feel the depressing influence of the new competitive supplies. It is not only in Ceylon and Malaya that rubber trees are being planted and developed, but also in various parts of Africa, India, Samoa, the Philippines, Mexico, Central America, and the West Indies. And when one has to deal with an existing annual supply of about 65,000 tons only, it will not be very long before the production is doubled. The efforts to increase the supply are all for the good as regards the industries which use rubber in its various manufactured forms, and which at present have to pay artificial prices for it, but the world-wide nature of the present activity makes the outlook less promising for the shareholders in new rubber-growing companies. New companies are really some years behind the fair, since their trees will not be producing rubber till after the pioneers in Ceylon have had several profitable seasons.

RUBBER MANUFACTURES

The elasticity of rubber is its great quality which adds to its utility. If kept in ice elasticity of rubber vanishes but is restored in a temperature of 40° centigrade. In heat of 100° to 120°C again, the elastic power vanishes. In 150°C, rubber softens down to jelly and altogether dissolves at a temperature of 200°. It also gets dissolved in Carbon disulphide, refined petroleum, ether, chloroform, liquid naptha.

There are various well-known processes of dissolving rubber and purifying it and preparing what are called (1) 'Masticated' (2) 'Vulcanised' rubber—the latter being an admixture of sulphur. When the admixture of sulphur is about 40 p.c., rubber is turned into ebonite, which is used in making combs, buttons, and innumerable other articles of every day use.

A large capital is not required for starting a manufacturing industry, but what is essential is the requisite technical knowledge and tools and plant.

At all events, whether from the point of view of cultivation or manufacture, rubber opens up before India immense possibilities in the near future and is well-worth the serious attention of our rich men.

Toy-test of Rubber.—Toys as an indicator for investors would assume a rather novel role. Yet the infant's rubber "soother" and the small girl's rubber doll are going up in price, and this rise is due to the enormous demand for rubber, caused by the extension of the motor car and allied industries. The cautious investor scrutinising stock and share lists may gain courage now to plunge in rubber. Let him watch the toy shop windows and they will reveal to him the state of the rubber market. When the *6d.* doll reaches a shilling, or when the *1d.* catapult is priced at *3d.* then he may be sure that rubber is booming.

Rubber in Travancore.—There are several applications for land for rubber cultivation still before the Travancore Government, says a writer in the *Madras Mail*, some of them dating from 1904, and these applicants have received no definite reply as yet, but have been told that a large area of forest is being demarcated into blocks of 500 acres, with a view to being auctioned. The auctions were first intended to be held last August, but no move was made in Trevandrum; and now after the lapse of two more months, we are told that the ownership of the tract in question is in dispute, and that there is very little probability of planters being able to secure land for some time to come. As far as can be seen, this is nothing more than an endea-

vour to "choke off" the planter. If the Government of Travancore really wishes to attract capital to the State and to encourage rubber planting, it would not take them long surely, to find suitable forest land, the ownership of which is not in dispute, and throw it open to rubber-planters. It is possible, however, that the present *impasse* suits their book better, though it does not inspire confidence in the honesty of their intentions. Meanwhile, capital that might flow freely into Travancore is being diverted into other channels, and elephants and other denizens of the *jungle* hold sway over a third of the area of the Maharajah's dominions. The State at the same time grows poorer year by year. How, indeed, could it be otherwise? *Quem Deus vult perdere prius demantat.* We can only hope that this short-sighted policy will soon plunge the State into such difficulties that the British Government will be compelled to interfere.

Rubber in Assam.—Dr. Harold Mann, who is well-known in Calcutta as the Scientific Adviser of the Indian Tea Association, contributes an article in the new number of the *Agricultural Journal of India* on "Assam Rubber and its Commercial Possibilities." It is believed, says the *Statesman*, that the paper will cause a flutter in the dovecotes, for Dr. Mann is said to have formed a far from optimistic opinion of the prospects of rubber from a financial point of view.

The Government of Mysore have again sanctioned a grant of about 300 acres of land for rubber cultivation, in which the Dewan is keenly interested. The grantee is Mr. Pilkington and the grant is free of assessment for the first five years.

Para Rubber.—Experiments in the cultivation of Para rubber (*Hevea Brazilensis*) in the Tenasserrim Division of Burma from seed imported from Ceylon by the Agricultural Department proved unsatisfactory in the year ending June 1906. Late sowings were responsible for the unsatisfactory results.

TANNING AND LEATHER INDUSTRY

Indigenous manufactures are steadily giving way before the forcible onrush of foreign competition. This is as true of the leather industry as of all others.

Mr. Rowland Chandra P.C.S in his monograph on the Tanning and Leather-Working in Bengal (Printed at the Bengal Secretariat Press; Calcutta, Price Rs. 1-12), observes as follows :—

"The effect of foreign competition is not, however, limited to

manufactured articles only. It is to be found in the case of raw materials as well. Raw skins and hides are collected and bought up by hide merchants, who have their agents in all districts and are exported to Europe and America, whence they are returned to this country mostly as unwrought leather, and partly as leather manufactured, we thus see that the effect of foreign competition is double. It is drawing out of the country its stock of raw materials, hides and skins, causing the prices of what are left to rise very high. It is also supplying the markets with manufactured articles at such a moderate cost that the prices of the indigenous manufactures must be lowered and their outturn reduced, if the industry has still to be carried on by the natives."

LIST OF TANNERIES IN BENGAL

The principal centres of the industry are Calcutta and its Suburbs, Patna, Dinapur, Darbhanga, Dacca, Cuttack, Monghyr and Hazaribagh. There are no tanneries in the Districts. In Calcutta and its vicinity, there are 17 tanneries, of which 7 are owned and managed by Europeans and 10 by Indians.

The following is the list :—

1. Monteith & Co., (Tannery at Ballygunge.)
2. Cuthbertson and Harper.
3. Morrison, Cottle & Co.
4. C. Galstaun and Son.
5. Watts & Co.
6. G. Wense & Co., (Bentink Street).
7. Chowson Chinaman's Tannery in Entally.
8. The Calcutta Tannery in Beniapukur.
9. The Bengal Tannery in Beniapukur.
10. Satcory Sircars Tannery in Beniapukur.
11. Mokim Sircar's Tannery in Beniapukur.
12. Munshi Jonabali's Tannery in Beniapukur.
13. Kurraya Tannery in Beniapukur.
14. Mohamed Ishaq's Tannery in Beniapukur.
15. John Teil & Co.'s, Tannery in Watgunge, established in 1769 — the oldest Tannery in Bengal, if not in India.
16. Tangra Tannery—agents Jardine Skinner & Co.
17. J. H. H. Pereira & Co., Entally.

TANNING INGREDIENTS

Besides lime, black salt, the following materials of *Jungle* produce are mostly in use :—

(*a*) Harra or Horitaki (myrabollam).

(*b*) Babul (Acacia Arabica).

(*c*) Amla or Amloki (Phyllanthus Embleca).

(*d*) Asan, *Sal Sakhna* and *Garan*.

(*e*) Mahua, Arjun, Bahera.

(*f*) Gab.

(*g*) Jiyal. (জিয়ল)

(*h*) *Jamur.*

The tanning materials are furnished by the barks, roots and leaves—the greater part of which being waste products are available in plenty in the country with nominal or no cost and a good trade can be carried on with almost no capital.

SUGGESTIONS FOR THE REVIVAL OF THE INDUSTRY

Mr. Chandra makes the following observations :—

'The last 50 years has been a record of the continuous decline of the industry, and it will not be long before the manufacture of boots and shoes from native-made leather will cease.

The revival of the industry depends upon a number of circumstances of which the following appear to be the principal :—

(1) Better raw materials which means better breeds of cattle.

(2) Discouraging the exportation of the raw materials from the land.

(3) Production of superior quality of leather.

(4) Cheapening the cost of tanning and economising the time spent on it.

(5) Manufacture of superior articles of leather.

The last three conditions presuppose the establishment of a number of tanneries all over the country to be managed by experts, who have received a thorough technical training in the most up-to-date methods, whether in the country or abroad.'

Mr. Chandra concludes with the following remarks : —"The exportation of raw hides and skins will in course of time, die a natural death as the establishment of tanneries will create a demand for raw materials. But the future of the industry is not confined to production of superior leather and leather articles. The industry is susceptible of expansion by the inclusion of raw materials of which no use is made at present. Little use is made at present of pig skins and the skins of guana. No use is made of the hides of horses and asses. The use of the hides of crocodiles and alligators and the furs of wild animals is

unknown. Some use can no doubt be made of dog skins of certain kinds. Fancy articles may be prepared from the skins of snakes and frogs (*vide* article on Frog-trade before).

Thus, materials are available of which no use is made at present but which can be turned into marketable products.

From the fact that there are good tanneries in Calcutta, Cawnpur and Agra, it does not follow that if tanneries could yield a good profit in Bengal, they would have been opened by this time. The question is not one of profit at all but of knowledge in up-to-date methods of tanning and working in leather, and of capital, two factors essential to the establishment of tanneries.

Capital, it is believed, will not be wanting when expert knowledge is available.

The circumstances which regulate profits are apparently in favour of, and not against, the establishment of tanneries in the interior of Bengal and may be summed up as follows :—

1. Small supervisional cost.
2. Cheap cost of labour.
3. Cheap cost of materials.
4. Cheap ground-rent of factory.

THE CHROME LEATHER

The characteristics of the Chrome leather, *i.e.* leather prepared under the latest process of manufacturing leather, called the 'chrome process' are thus described by Mr. C. T. Davis in his "Manufacture of Leather."—

"Chrome leather has special and peculiar qualities which distinguish it from all other kinds of leather and their special features, cause it to be a superior fabric for all purposes for which leather is used.

All kinds of leather produced with tannin absorb water readily, like a sponge, while chrome leather does not absorb water, but resists it, or sheds it, like the feathers of a duck. Again, water and air are the agencies in nature which promote decomposition and decay; and as tannin and hide substance are both organic materials, and when combined, as in the case in bark-tanned leather, and subjected to the process of wetting and drying, such leather will eventually but surely deteriorate and become rotten. Chrome leather, on the other hand, being a combination of an inorganic material with the hide substance and subjected to the same process of wetting and drying, shews no effect whatever.

Moreover, chrome leather is of much lighter weight than bark-leather, and this is a decided advantage for almost all purposes for which leather is used."

Mr. Talati, a Parsi gentleman, proprietor of the Minocher Leather Works in Bombay, learnt the process in America some years ago, and. on his return to India, made experiments in it in his factory and found it suitable to this country. The old process of bark-tanning takes a month at least to tan a goat-skin, whereas the chrome process requires only a day. Cow-hide, calf-skins and sheep-skins can all be chromed like goat-skins. The process has also been introduced into the Madras tanneries, and a great future is expected of it. Professor Chatterton, of the Madras Government School of Art, considers chrome leather as the most suitable for water-buckets and water-bags. As to profit, Mr. Talati is of opinion that it will be mainly regulated by the following circumstances :—

1. Price of raw materials.
2. Rent of factory ;
3. Wages of workmen ;
4. Supervision of the proprietor ;
5. Nearness of port ; and
6. Honesty of the workmen.

The process in his opinion may be learnt in two to six months according to the intelligence and application of the learner. It is clear, this process has a great future in this country, and the sooner it is introduced the better. The establishment of good tanneries will take time, but in the meanwhile, the existing native tanneries in the Suburbs of Calcutta may well start the work of manufacturing chrome leather. Time is valuable and competition is keen in every business, and unless prompt action is taken, very little fruit can be expected.

THE MADRAS SCHOOL OF ARTS AND CHROME TANNING TRAINING

Mr. Alfred Chatterton—the officer in charge, answers as follows, certain inquiries made to him :—

(1) A thorough training in the tannery here, will require from 3 to 6 months depending upon the student's aptitude for the work and his previous knowledge of the tanning business.

(2) There is no boarding house attached to the School of Arts.

(3) A Bengali's monthly expenses in Madras will be between Rs. 30 and 35 a month.

(4) A special knowledge of Mathematics is necessary, but a knowledge of Chemistry is desirable.

(5) There are no rules regarding the admission of students into

the Chrome Tanning Department of the School of Arts. Students can join at any time and have to comply with the regulations in force.

REPORT OF WORKING OF THE MADRAS SCHOOL

From the report submitted to Government by Mr. A. Chatterton, Superintendent of the School of Arts, Madras, on the working of the School's Chrome Tanning Department, during the year ending the 31st March 1906, it appears that the average output rose from Rs. 400 a month in 1904-05 to nearly Rs. 2,500 a month in the following year: and Mr. Chatterton adds, it is likely to go on increasing at the same rate. The operations, as admitted by the Board, have provided a useful industrial object lesson in so far as they have proved that excellent chrome leather can be manufactured in this country, and that such leather is well adapted for various articles commonly used by the people. A little more advertisement appears to be wanted. As regards the future of his Department Mr. Chatterton says—"a great deal remains to be done before we can safely withdraw from this enterprise," which has, to quote the Board's Resolution, "disclosed the possibility of an entirely new industry, which if properly developed may change the face of the leather trade of the country, provided the alleged superiority of chrome-tanning is established to the satisfaction of the public and that this industry can be demonstrated to be commercially profitable."

BOOK ON TANNING

The best book on tanning, according to Mr. Chatterton is "The principles of Leather manufacture by H. R. Proctor."

Mr. CHATTERTON'S CIRCULAR ON THE CROME LEATHER INDUSTRY.

The following Circular on the above industry has been addressed by Mr. A. Chatterton to the Members of the District Agricultural Associations throughout the Madras Presidency, (1906). For the last two years, the manufacture of chrome leather has been carried on as an experimental industry in the School of Arts, Madras. At the beginning, the work was purely experimental, but now it has reached the commercial stage and our efforts are mainly directed

to the development of the market for a product which has been proved admirably suited to the requirements of the natives of this country. We have completely demonstrated :—

1. That chrome leather can be manufactured in India without any difficulty.

2. That the leather so manufactured is vastly superior to leather manufactured by any of the vegetable tanning processes.

3. That the cost of conversion of hides and skins into chrome-tanned leather is not greater than when the bark-tanned process is employed.

4. That for agricultural purposes and especially for *kavalais*, chrome-tanned leather is much more durable than bark-tanned leather.

The tanning trade in the Madras Presidency is the most important of all native industries. The export trade alone amounts to nearly 3 crores of rupess a year, and it is probable that the value of the leather consumed in the country, is at least as great. The chief item in the cost of producing a piece of finished leather is the value of the raw material, and it is probably within the mark to estimate the value of the hides and skins in this Presidency at something over 4 crores of rupees annually. The Provincial land revenue of the whole Presidency is only 2½ crores of rupees; so that this one product alone, being 50 per cent greater, is worthy of at least as much care and attention as has of recent years been given to the incidence of the land tax.

The universal employment of chrome leather in place of that now made in this Presidency by the old tanning processes would lead to enormous reduction in the quantity of raw material required to satisfy the wants of the Presidency. The experience of the last two years shows that chrome leather is much more durable than bark-tanned leather, and that it may be used with advantage, not only for *kavalais* but for sandals, boots and shoes, harness, etc., and the raw material which can thus be saved is available for export to foreign markets where there is an ever-increasing demand. From an economic point of view, the chrome leather industry is extremely important to India, because it will enable supplies of raw material for export to be enormously increased.

It seems, therefore, that the District Agricultural Associations may with great advantage to themselves, take an active interest in the introduction of the use of chrome leather throughout the country. The difficulty of introducing a new product into India is well-known and the District Agricultural Associations may render useful help by bringing to

the notice of the ryots the valuable properties of this new material. This, the members, can individually, do by purchasing chrome-tanned leather manufactured in Madras, and using it on every available opportunity instead of the inferior local product to which they have hitherto been accustomed. But better still, the Associations can do more useful work by setting up experimental installations to which ryots and skin dealers can bring their raw materials and have them converted into chrome leather for such sum as will cover the working expenses. Leather manufactured at the School of Arts or at any of the tanneries in Madras, costs more than it need to in the Mofussil, and moreover, the purchase of a chrome leather *kavalai* by a ryot involves a much bigger monetary transaction than he is accustomed to, and there is but little doubt, that he would much more readily send the hides of his dead cattle to be made into chrome leather if he could do so by simply paying the tanning charges.

For the establishment of District Chrome Tanneries, a capital outlay of about Rs. 1,000 would suffice, provided there are already in existence, buildings in which to carry on the work and lime pits in which to get the unhairing done. There are a considerable number of students with a fair practical knowledge of chrome-tanning available in the School of Arts, Madras, and there will probably be no difficulty in getting them to take charge of these District Tanneries, if they are paid Rs. 50 to Rs. 60 a month. The manufacture of chrome leather for agricultural purposes is an extremely simple business, and one which can be learnt in a comparatively short time as it is quite unnecessary that at the outset any attempt should be made to produce a material better than what is really necessary for the requirements of the ryot. If the District Associations are prepared to take the matter up, I shall be pleased to assist them in every possible way and to guarantee that on the manufacturing side at least there will be no chance of failure.

THE BENGAL DYERS & SKINNERS CO.

It is reported, that a company of the above name has been started at Bansra in the Burdwan Division for tanning hides with extracts of *Myrabolam*. Our enterprise ought to be more in evidence in this direction.

A BRAHMIN TANNER IN DECCAN

In the Deccan an educated Brahmin youth of the name of Rajaram son of a wealthy gentleman is reported to have got over traditional caste prejudices and started a leather factory. He travelled all over India and saw for himself the working of various tanneries. The practical experience thus gained is sure to stand him in good stead in his admirable venture. This is, as it should be, and we commend his example to our brethern on this side of the country.

TANNIN-YIELDING PLANTS IN INDIA

Among Indian tannin-yielding plants under investigation, officially both in this country by the Economic Products Department and at Home by the Imperial Institute in London are the following:—*Cassia auriculata*—A report on the tannin value of the barks sent home is under preparation by the Imperial Institute. *Casalpinia coriaia.*—The official enquiry as to the possibility of making use of this plant in India is being still prosecuted. *Casalpinia digyna*—The results of experiments by a large Cawanpore firm to ascertain the value of the pods for tanning, have so far been disappointing and at variance with results obtained in Europe; further experiments are, however, to be undertaken. *Xylia dolabiformis*—The questions of the possibility of making extract of *Xylia* wood commercially is under examination out here.

SOAP-MAKING IN INDIA

"It is my humble opinion that Indians should pay much more attention to industrial arts than to politics. So I learnt the art of Soap-making. I have obtained a gold medal in the recent Industrial Exhibition held at Amraoti (Berar) in April, 1906. As our countrymen are backward in such arts I have resolved to open a soap class at Satara on the 25th of July, 1906. I shall teach the practical side of soap-making giving also some theoretical information. Any native of India, Burma, or Ceylon will get admission without distinction of caste. Soap-making is a lucrative business. A capital of 5,000 rupees will pay about Rs. 200 as net monthly profit. Rs. 1,500 will pay about 50 rupees per month."

S. Gokhale,
Medical Practitioner and Soap-maker, Satara.

ESTIMATE FOR STARTING SOAP FACTORY ON A MODERATE SCALE

Office Staff

Superintendent,	Say	@	Rs.	125	per month			Rs.	As.	P.
1 Head Clerk	,,	,,	,,	30	,,	,,				
1 Asst. Do.	,,	,,	,,	20	,,	,,				
1 Sarkar	,,	,,	,,	15	,,	,,				
1 Peon	,,	,,	,,	8	,,	,,				
1 Servant	,,	,,	,,	6-8	,,	,,				
							=	204	8	0

Factory Staff

1 Soap boiler	@	Rs.	20	per	month				
4 Coolies	,,	,,	32	,,	,,				
2 Mistris	,,	,,	20	,,	,,				
1 Durwan	,,	,,	8	,,	,,				
						=	80	0	0

Tear and wear @ 6% on Rs. 5,000 (*vide* below money blocked up in machinery, &c.) ...	Rs.	As.	P.						
	25	0	0	per month					
Repair @ 3% on Rs. 5,000	12	8	0	,,	,,				
Tax, &c....	10	0	0	,,	,,				
Stationery	10	0	0	,,	,,				
House rent	50	0	0	,,	,,				
Advertisement	158	0	0	,,	,,				
Interest of Rs. 2,500 (*vide* below) @ 12%	25	0	0	,,	,,				
Extra margin	25	0	0	,,	,,				
						=	315	8	0
Monthly Establishment							600	0	0
Yearly							7,200	0	0

COST OF MACHINERY AND PLANTS

Rough Estimate

Machinery :—		Approximate Price. Rs. As. P.
1 Plodder 1 Mill 1 Cutting Machine 1 Stamping Machine	...	1,500 0 0

	Rs.	As.	P.	
1 Oil Engine 4 H. P. ...	1,800	0	0	
1 Card board Cutting Machine ...	100	0	0	
7 Soap moulds @ Rs. 30 =	210	0	0	
				Rs. 3,610 0 0
Block :—				
4 Coppers	200	0	0	
1 Tank	20	0	0	
2 I. Drums	20	0	0	
4 Buckles	3	0	0	
4 W. boxes (flat)	8	0	0	
3 W. boxes (big-square) ...	30	0	0	
4 Small Tables	25	0	0	
1 Counter	15	0	0	
2 Almirahs	25	0	0	
2 Racks	30	0	0	
8 W. box-Frames	4	0	0	
20 B. Trays	10	0	0	
				Rs. 390 0 0
Office Furniture	100	0	0	
Cost of Setting up the Machinery	150	0	0	
Godown	500	0	0	
Margin	250	0	0	
				Rs. 1,000 0 0
				Rs. 5,000 0 0
Capital ...	10,000	0	0	
Loan ...	2500	0	0	
	12,500	0	0	

Block Rs. 5,000 Working Capital Rs. 7,500

AN ESTIMATE OF LOSS AND PROFIT

(For secrecy, code words are used everywhere)

FORMULA

Curd No. 1.

For Rosena Soap, better in quality than the Otto, Maharaja of the Bengal Soap Factory, which is selling @ 1-8-0 per box of 3 tablets, and 12½% commission allowed,

	lbs.		Rs.	As.	P.		Rs.	As.	P.
Allabu	50	@	0	4	6	=	14	1	0
Agabu	175	@	0	2	9	=	30	1	3
Acabu	50	@	0	3	0	=	9	6	0
Olibu	25	@	0	10	0	=	15	10	0

300 lbs. of curd soap.

	lbs.		Rs.	As.	P.		Rs.	As.	P.	
Assoddi	75	@	0	1	9	=	8	3	3	This will be Evaporated.
Ashio	50	@	0	0	9	=	2	5	6	
Stumi 4 mds.		@	0	6	0	=	1	8	0	
Muiyu 1000 gallons						=	0	8	0	
							81	11	0	

No. 1. curd soap 300 lbs. @ about 4 As. 6 P. per lb.

ROSENA SOAP

To be prepared by No. 1 curd Soap formula of which is already given above.

	lbs.		Rs.	As.	P.		Rs.	As.	P.
No. 1 Curd Soap	84	@	0	4	6	=	23	10	0
Akko	8	@	0	1	3	=	0	10	0
Ekko	4	@	0	1	6	=	0	6	0
Kekko	4	@	0	0	6	=	0	2	0
Uggly	4	@	0	10	0	=	2	8	0
Esona	1	@	0	8	0	=	0	8	0
Enoy	$1\frac{1}{4}$	@	40	0	0	=	50	0	0
Mizpa	5	@	0	1	0	=	0	5	0
	$111\frac{1}{4}$ lbs.						78	1	0

	Rs.	As.	P.
=183 boxes of 3 cakes each weighing 8 tolas	78	1	0
Cost of 183 boxes @ 6-4	11	7	0
Cost of 183 labels @ 9p. } Cost of packing @ 3p. } ...	11	7	0

			Rs.	As.	P.
Kerosine ...	...	...	2	0	0
Reserve for sinking Fund ...		...	5	0	0
183 boxes cost price Rs. ...		...	107	15	0
Keep aside 3 boxes for sample					
180 boxes or 15 dozens ...		Rs.	107	15	0
Whole sale price of 15 dozens @		...			
11 0 0		...	165	0	0
Cost price ...		...	107	15	0
Profit Rs. ...		...	57	1	0

52½ per cent.

YEARLY OUT TURN

FOR THE FIRST YEAR

100 lbs. daily.

ROSENA SOAP.

		Sale price.	Cost price.	Profit.	Reserve.
In one day	15 dozens	Rs. 165 0 0	Rs. 107 15 0	Rs. 57 1 0	Rs. 5 0
	30	30	30	30	30
In one month	450 dozens	Rs 4950-0	Rs. 3238-2	Rs 1711-14	Rs. 150
	12	12	12	12	12
In one year	5400 dozens	Rs. 59400	Rs. 38857-8	Rs 20542-8	Rs. 1800-0
	* 2700 dozens	Rs. 29700	Rs. 19428-12	Rs. 10271-4	Rs. 900.
Establishment @ Rs. 600 per month		...	...	... 7200	
				Rs. 3071 4 0	
		Net Profit	..	Rs. 3071 4 0	
		Reserve Fund	...	,, 900 0 0	

POTTERY AND PORCELAIN

After agriculture and weaving, *pottery* appears to be the most considerable, ancient, and finished industry of this country. Unglazed pottery can be traced from a period even earlier than the im-

* The capacity of the machinery would be to turn out 4 to 500 lbs. of soap daily *i.e.* 60 to 75 dozens daily. Let us estimate 50 lbs. daily for the 1st year. If soaps or even Rs. 20,000 can be sold a year, in that case also there will not be any loss. The formula of 1 kind of 1st class soap is given. There will be different kinds of soaps, and no soap will yield less than 40 °/° profit.

migration of the Aryans. Some of its most perfected specimens are to be found depicted in many of the Hindu and Buddhistic sculptures of the pre-Christian era. As to glazed pottery, doubts have been freely expressed about its indigenous origin. But the glazed tiles that have been found in the ruins of Gaur, the ancient capital of Bengal, and the glittering gilt tiles that covered the roof of the palace at Tughlakabad (Delhi), distinctly prove their Indian finish. There can, however, be no room for doubt that, the art of glazing earthenware in India received a great impetus from her early Mahomedan conquerors. Some of the best glazed Indian pottery are now made at Kurrachi and Hyderabad, in Rajputana and at Bulandshahr, Peshawar, Rampore, Lahore, Multan, Delhi, Dinapore, Chunar, Benares, Azimgarh, Bombay, Vellore, and Madura, and the best clay figures at Krishnagar in Bengal and at Lucknow and Poona.

But the palm in pottery must be yielded to China for its porcelain and to Greece for its ornamentation. The absolute scarcity of any *kaolin* in India is responsible for the absence of porcelain manufacture in this country.

CLAYS

No statistics approaching any degree of completeness are obtainable to show the extent of the undoubtedly great industrial value of the clays in India. They include the common clays used all over the country for the manufacture of bricks, tiles and the cheaper forms of pottery; finer varieties used for glazed pottery, which in places has obtained a reputation for artistic merit; fire-clays raised in considerable quantities on some of the Gondwana coal-fields; and fuller's earth, which is mined in the Central Provinces and in Rajputana.

The imports of materials coming under this head show that there is room for the development of the raw materials which are suitable for the manufacture of articles required in a modern civilized community. In 1903, the value of earthenware and porcelain imported, amounted to £ 187,390; of earthenware piping, £ 6,659; of clay, £ 6,186; and of bricks and tiles, £ 38,618. (Holland —Mineral Production of India).

KAOLIN (CHINA CLAY) IN BENGAL

It is reported that large quantities of *kaolin* (China clay) have

been found in Mandalghat in the estate of the Maharajah of Cassimbazar and that the Maharajah is trying to utilise them in the manufacture of high-class pottery and porcelain. The discovery of *kaolin* in India must tend to create the porcelain industry in this country.

American Cement.—An interesting announcement is made to the effect that the United States Steel Corporation is perfecting plans to dominate the cement industry of the country. They have already incorporated the Universal Portland Cement Company, with a nominal capital of $ 1,00,000, which will take over on October 1st, the plants and business of the cement department of the Illinois Steel Company, and later, it is proposed to erect a $ 3,000,000 plant in the vicinity of Pittsburg, which will increase the output by some 150 per cent. When these plants, which will be paid for out of an appropriation made by the management of the Steel Trust last spring, are completed, the yearly output will amount to about 6,000,000 barrels, or 10 per cent. more than the entire output of all the other plants in the country. It is claimed that the cement business will be a very profitable one for the Steel Trust, with its splendid facilities to engage in, and is one that will enable it to make use of its slag, which up to the present time has been practically valueless.

FAMOUS KRISHNAGHUR (BENGAL) CLAY-MODELS— A DYING ART

The clay-modelling handiwork of the Krishnaghur (Nadia) potters, has always been an object of wonder and admiration. But as is the case with all fine arts of the country, it has fallen into a neglected and moribund condition. It will be nothing short of a national calamity if such an ancient and high class art is to die out before our eyes for want of support and encouragement.

Even at the present day, there are one or two artists who can prepare lifelike images of any one in a few minute's sitting. If it could be possible to give to the innate talent of these men the polish of foreign culture of a high order, say, in Italy or France, what great possibilities would not be opened up before the country?

Images of our Hindu deities or representations of Indian life and scenery are made much of in Europe and America. If these could be done in the Nadia potters' best style and systematically shipped to the principa

marts in Europe and America, a brisk business would be a going which would not only pay its way but contribute somewhat to the revival of this once famous industry.

GLASS-MAKING MATERIALS IN INDIA

The common, impure sands of the rivers and the efflorescent alkali salts, so common in many parts of India, are used in various places for the manufacture of the inferior varieties of glass used for bangles; but attempts to make the better kinds of glass on a large scale, have hitherto failed in India.

The chief difficulty in the way of manufacturing the better grades of glass in India, is the absence of known deposits of quartz-sand of the requisite purity and of suitable texture. For the finer qualities of glass, the sand which is, of course, the chief natural substance used, should be rather fine and uniform in grain, angular rather than rounded, and perfectly white. For the commoner kinds of glass, in which colour is of no importance, a considerable quantity of impurity can be tolerated and allowed for in making up the melting charge. The well-known Fontainebleau sand of France, used largely for glass-making, will yield as much as 99 per cent. of silica, with 0·50 per cent. of alumina and a trace of iron oxide; but good window glass can be made from sand, containing iron oxide up to ·02 per cent., without the use of the corrective manganese oxide.

To what extent a glass-making industry would find a market in India, may be judged by the fact, that during the past six years the annual import of glass and glassware have gradually risen in value from £441,529 in 1898-99 to £661,377 in 1903-04

MR. WAGLE'S PROPOSED GLASS FACTORY

It is understood that Mr. Wagle has decided to open his proposed glass factory in Bengal. The site is likely to be either Barakar or Giridih.

PART IV.

COTTON GROWING IN THE BRITISH EMPIRE.

Sir Alfred Jones performed the opening ceremony in connection with the Liverpool Colonial Products Exhibition in St. George's Hall on Feb. 5, 1906. The exhibition is proving a great success, and Sir Alfred expressed the hope that a permanent exhibition would be established in Liverpool and so afford them constant opportunities of seeing what the colonies can produce. British people, when they knew what the Colonies could do would give them a preference over the foreigner. There was no reason why we should not get everything we required from the colonies which should be brought into a respectable kind of partnership with us. Referring to the efforts of the British Cotton-Growing Association, he said that unless Lancashire looked after cotton-growing in the empire, they could depend upon it that she would find herself short of the supply she wanted, because America, in justice to herself was bound to provide herself first. The work of the Association had stimulated a zeal for cotton growing not only with the empire, but all over the world, and he felt sure that in a few years' time they would be getting ten times the quantity they were receiving to-day. Mr. J. G. Newton, chairman of the British Cotton-Growing Association, and Mr. J. H. Hutton, vice-chairman, also spoke, the latter gentleman remarking that they were determined to get every ounce of cotton that Lancashire required grown, if possible in the British Empire. It rested with the people of Manchester, Oldham, and Liverpool to say whether that cotton should be grown in the Colonies or not. They had proved that cotton could be grown in the Colonies and it was now merely a question of money. Both Liverpool and Manchester were dependent on the cotton trade, and Liverpool must do more than she had done in finding the capital necessary to promote the work of the British Cotton-Growing Association.

The reports of the British Cotton-Growing Association to extend the cultivation of cotton in various parts of the Empire have not been attended with uniform success. In the Niger region the plant flourishes, but in an adjacent part of West Africa climatic conditions seem to be rather against it, and the people will not undertake the

cultivation. It is now recognised that the growing of cotton in the Gambia territories on a scale suitable for export cannot pay at the present prices, and it is clear that the industry is at an end. The people prefer to cultivate groundnuts which give them a much better return for their labour.

GOVERNMENT RESOLUTION ON COTTON GROWING IN INDIA.

The following despatch to the Secretary of State for India, dated Calcutta, 31st August, 1905, is published :—

Sir,—During the visit of Lord Curzon to England, a memorial was presented to him by the British Cotton Growing Association, which on his return was taken into consideration by our Government. In view of the important proposals made by the Association for the extension and improvement of cotton cultivation in India, the memorial was referred by us to the Board of Agriculture so that we might obtain the benefit of the united advice and assistance of the representatives of all the Provincial Departments of Agriculture ; and we now have the honour to forward a copy of the enclosed correspondence upon a consideration of which we desire to make the following recommendations for your approval.

2. You have been kept informed from time to time of the action taken in this country with the object of improving the cultivation of cotton, and the appendix to the Board's letter gives a clear account of the measures now in progress in each province of India. We have carefully considered how these measures may be extended in the directions recommended by the British Cotton Growing Association. We agree with the Board of Agriculture that whilst it is inexpedient to create a separate Cotton Department distinct from the Department of Agriculture the number of experts in all provincial departments should be strengthened, so that a competent scientific staff may be employed not only for the improvement of cotton but for the investigation of the many other agricultural problems of India. More specific recommendations for the appointment of additional experts will be made after consideration of the detailed proposals of Local Governments upon the schemes for the expansion of the Provincial Departments of Agriculture which have been framed in consequence of the sanction given in your telegram, dated the 10th February, 1905, to an increased annual expenditure of twenty lakhs upon agricultural development. The problem of the improvement of cotton has not been neglected by the small staff

available in the past, and it will receive still greater attention from the increased staff that we propose to employ in the future.

3. It is important that there should be a Cotton Specialist, whose services will be wholly devoted to cotton questions and who will continually visit each province, co-ordinate the cotton experiments in progress under the control of the Provincial staff, and assist them with his advice and guidance based upon his larger experience and knowledge of the results of similar experiments in other parts. We do not consider that this duty, in addition to the many other duties of the appointment, can be performed by the Assistant Inspector-General of Agriculture recently selected by you, who we understand has no special knowledge of cotton cultivation. We therefore ask for your sanction to the creation of an appointment of a Cotton Expert on the staff of the Imperial Department of Agriculture. The qualifications required for the post include a sound education in scientific agriculture combined with a knowledge of the methods of cotton cultivation practised in America or Egypt (preferably both) together with an acquaintance with the recent work of the Agricultural Departments of those countries. Special importance is attached to a knowledge of scientific agriculture, so that the officer may not only have an expert knowlege of the different systems of cultivating cotton, but may be able to adopt the principles under-lying them to the local conditions of India. If it is found impossible to secure a candidate with these qualifications, we suggest that an expert agriculturist should be selected, and should be required before coming to India to visit America and Egypt in order to acquire the special knowledge mentioned above. We leave it to you to fix a salary sufficient to secure the services of a thoroughly competent expert. His appointment should be on three years' probation in the first instance.

4. With regard to the important matter of seed selection and distribution you will observe that the Board of Agriculture suggested, with considerable hesitation, the possibility of establishing three large Cotton Seed Farms. The Local Government, who were consulted by us upon this suggestion, unanimously recommend that this poposal should be deferred, because the stage has not yet arrived when any improved variety can confidently be recommended for general cultivation, and that the growing of selected varieties for seed should first be conducted on a smaller scale, until more experience is gained of cotton experimental work so as to avoid the risk of failure. They propose to provide

Government Experimental Farms in all the important cotton tracts and to add to each a substantial area, which will be devoted to the production of selected seed. We have approved of these proposals, which will do much to secure a supply of good seed for distribution to cultivators in conjunction with the scheme for the selection of seed on a larger scale from cultivators' fields (which was explained in the Circular, a copy of which was forwarded with our Under-Secretary's letter No. 136, dated the 22nd September, 1904), and other measures now in progress, such as the co-operation of some ginning factories in the separate treatment of the best pickings of the best varieties, the encouragement of private seed farms, and the like.

5. In other directions much is being done to meet the wishes of the British Cotton Growing Association. A botanical survey of the varieties of Indian cottons has been completed by Professor G. A. Gammie, F. L. S., of the Poona College of Science, and the practical testing of varieties is in progress at all Goverment cotton farms in order to decide the most suitable variety for growth in each tract. Some successful preliminary trials of Egyptian and American exotics have been made in Sindh and the Panjab, and a careful investigation of the tree cottons is being made by the Indian Long-stapled Cotton-Growing Syndicate in Bengal and at Goverment farms in some other provinces. We have recently issued instructions for the improvement of the forecasts of the cotton crop, a copy of which was forwarded with our Despatch No. 11, dated the 27th April, 1905. The Board of Agriculture points out that improvement in the methods of cultivation is largely an economic operation dependent upon the resources and character of the cultivator, and our Inspector-General of Agriculture has initiated in all provinces a scheme of experiments for testing the results of the manuring of cotton, not only with the natural supplies available in the country, but with artificial fertilizers. Our existing system of loans to agriculturists which is at present under careful investigation with a view to its improvement gives facilities for affording financial assistance to cultivators.

6. Whilst we do not doubt that these measures will lead in time to the improvement of Indian cotton, we desire to emphasize the views expressed by Sir Denzil Ibbetson in his speech at the meeting of the Legislative Council on the 29th march last that the problem is largely a commercial one, that the cultivators will not abandon the course, hardy, prolific varieties for the fine, delicate varieties, until they are satisfied that the

latter yield the greater and surer profit. Our object must be to make cotton of any kind, without regard to the length of staple, more certainly paying crop to the Indian cultivator whilst, we understand that one main object of the British Cotton growing Association is to increase the production of the long-stapled varieties suited to the needs of Lancashire. These objects are by no means antagonistic, as the Association themselves remark, and as will be seen from the above account of our action. We are inclined to think that the Association can best assist in their attainment, so far as India is concerned, by aiding in arrangements adopted with the view of securing that the Indian cultivator who grows a good sample of high quality cotton may reckon on getting a price for his produce, however small in quatitity, better than the market price for the larger supplies of poor quality cotton. If the Association desire to give financial assistance for the improvement of Indian cotton, the most practicable method would seem to be for it to make an annual grant, which could be utilized under our orders, either in giving a subsidy to the cultivator for every acre of fine-staple cotton grown by him on the recommendation of the local Department of Agriculture, which would make special arrangements to help him in securing a fair price for his superior cotton, or in compensating him for any loss incurred in the initial stage of such cultivation. If this suggestion meets with the approval of the British Cotton Growing Association, we shall be prepared to give all possible assistance to its execution.

7. In conclusion we beg that our acknowledgments may be conveyed to the Association, not only for their offer of financial aid but for the valuable advice they have placed at our disposal. We trust that the steps which we have already taken and those which we now propose to take will ultimately result in a marked improvement, both in the quantity and quality of the cotton produced in India, and will thus not only add to the prosperity of the Indian cultivator but benefit the manufacturers and consumers of cotton throughout the world.

The report is signed by all the members of the then Executive Council.

MR. BRODRICK'S APPROVAL.

On the 27th October 1906, Mr. Brodrick wrote :—

"I sanction the proposal that a cotton specialist whose services will entirely be devoted to cotton questions should be added to the staff of the Imperial Department of Agriculture. I shall take steps

to select an expert having the qualifications which you enumerate. The other measures which you are taking or intend to take to improve the quality of Indian cottons have my general concurrence. I shall cause the suggestion made in your letter to be communicated to the British Cotton-growing Association for consideration and expression of their views."

THE ASSOCIATION'S RESPONSE.

On the 6th December 1906, Mr. Hutton wrote to the Under-Secretary of State for India :—

Council have decided to
our suggestion to the
t the Association should
annual grant which would
sed under the orders of
rnment of India. It has
cided to place at your
the sum of £10,000 to be spread over a period of four years at the rate of about £2,500 per annum to be devoted to the improvement and extension of cotton-growing in India. As to the exact method in which these funds should be spent, the Council are prepared to leave the direction entirely in your hands, as they feel quite sure that the Government of India will take sufficient care to see that the money is not wasted. I would, however, request that, as far as possible when advances are made it should be stipulated that the cotton grown should either be sent to this Association for sale and that the latter after repayment of advances hand over the surplus proceeds to the planter or that arrangement should be made as far as possible for money to be advanced on a business basis, so that there would be some possibility of at any rate some portion of it coming back again. If this can be done, I have no doubt the Council would be prepared to re-advance the money thus lent for a further period, and I would suggest a reasonable rate of interest should be charged. I shall be very glad to hear of any suggestion that the Indian Government may make as to the best method of utilising the above grant, but I wish to make it prefectly clear that the Council have decided to leave you an absolutely free hand in the matter, so that no time should be lost by referring matters back to this Association for consultation. All that is desired is that the Association should receive from time to time full particulars as to the manner in which the money is being spent.'

THE GOVERNMENT OF INDIA'S THANKS.

The Government of India, in their despatch of the 8th March,

1906, to the Secretary of State, say :—

"We would say that an expression of our cordial thanks may be conveyed to the Association for their liberal contribution. We have noted their suggestions regarding the manner in which they would wish the money to be utilised and they will be kept informed from time to time of its distribution. When the detailed scheme for the purpose which we have instructed our Inspector-General of Agriculture to elaborate has been received, we shall be in a position to state when the money will be required and a further communication will then be addressed to you for the information of the Association."

THE INDIAN COTTONS.

Among the many problems facing the Imperial Agricultural Department of India is the systematic classification of the numerous varieties of each kind of crop raised in the soil and the arrangement of the vernacular peculiarities met with in different parts of the country. When a census of the various forms of the plant has been completed, it will be easier to demonstrate to the cultivator the best kind to grow, the habits and requirements of the plant, and the localities in which he may obtain the seed. The improvement of the present staple crops is much to be desired, and although the philosophic adage regarding the production of two blades of grass where one grew before may be followed where suitable land is abundant, the same object would be attained if the grass could be made to grow to twice its usual height.

Of the many crops raised in Indian soil one of the most commercially important is that of cotton. Endeavours have been made for many years to improve and extend its culture in order to secure for the Indian product a more favourable position in the European market. One first difficulties, from an tural point of view, is the c that exists regarding the n forms and vernacular name cotton plant, and the relati which occur between the members of the genus Gossypium. Much discussion has taken place as to the origin of the cultivated plants : whether they are of Indian origin, whether they are hybrids, or whether they are developments from a protean ancestor dwelling originally in Asia, Africa, or America. During the last century the botany of the cotton plant has been described by various experts who have attempted to classify the cultivated varieties. but each writer has been followed by another, who after much criticism of his prede-

cessor's mistakes has evolved an entirely new system of classification. It is about a hundred years since Dr. Roxburgh penned his description of the cottons of Bengal, and from his time to within about twenty years ago very few new observations were recorded. In the Flora of British India four species are recognised—*Gossypium stocksii* (the indigenous plant of Sind), *G. herbaceun* (the *deshi* cultivated cotton), *G. barbadense* (the American cotton) and *G. arboreum* (the tree cotton). This arrangement was not followed by the Italian, Dr. Todaro, who advanced the theory that the vast majority
Indian cottons were hybrids
anifested a strong tendency
art from their recognised
ies. The next writer was
rge Watt, who in his "Dic-
of Economic Products"
rizes the results of all previous observers and classifies them with his usual literary skill. In 1895 Professor Middleton of the Agricultural College, Baroda, published a valuable paper on the Indian botanical forms of cotton. The descriptions were made from living plants which had been cultivated for four years under his supervision in the college farm. These were classified according to the districts in which they grew, and he refers them to what in his opinion at the time were the parent plants.

For the past five years many forms of Indian cottons have been grown at the Poona and Manjri Farms, Bombay, from seeds collected from almost all parts of India and Burma by the Inspector-General of Agriculture. These were kept under observation and experiment by Professor G. A. Gammie, of the College of Science, Poona, who now holds the botanical appointment under the Department of Agriculture, Bombay. The exceptional opportunities for studying the forms of the plant have enabled Mr. Gammie to publish a most useful report on the Indian cottons. The work has just appeared from the Government Printing Press and deals with the subject in a scientific manner. It is, nevertheless, written in so clear a style, and the paper is so well illustrated that it cannot fail to be of value to the Indian agriculturist for whose special benefit it is compiled. After making some general remarks on the peculiarity of the cottons of this country and describing the conditions of the experiments at Poona, the author divides the Indian cottons into nine distinct species and twenty-three varieties and sub-varieties. This part of the work is carefully done, so that with the aid of the short practical description of each, a cultivator in any part of India will be able to recognise the peculiar form of cotton plant he

is interested in. Another chapter is devoted to a study of the distribution of Indian cottons. Here the chief cottons cultivated in each province are enumerated, with the vernacular name of the crops, area under cultivation, historical notes, and opinions on the commercial values of the products. An important point in Mr. Gammie's researches is his conclusion that the flowers of Indian cottons do not hybridize by natural methods. Artificial hybrids have been obtained, but the so-called hybrids are merely cultivated races evolved by time and environment from one prototype.

An appendix is given showing the results of experiments made by Mr. Shevde on the relation between the length of the hairs and length of the staple in several varieties of cotton. This information will be of considerable value to manufacturers as well as being of scientific interest. Another appendix gives the percentage of lint to the seed, number of seeds in each cell, length of staple, and colour of flower, of all the varieties grown at Poona. Two maps accompany the work, one giving the cotton areas of India with the names of the species and varieties of cotton known to occur in each presidency and province, and the other the cotton areas of the Bombay Presidency. Many more years of experiment and observation are necessary to prove how climate, soil, and environment tend to influence botanical variation in the Indian cotton plants, but Mr. Gammie, in the work before us, has laid the foundation of a line of work which is of the utmost importance to Indian agriculture. The appearance of such reports indicate the thorough manner in which the Agricultural Department is undertaking its duties in grappling with some of the vital problems of the country's welfare.

EGYPTIAN COTTON.

INSTRUCTIONS FOR SOWI

The following instructi the sowing and cultiv Egyptian cotton, issued Deputy Director of Ag Bombay Presidency, will with interest.

PRELIMINARY TILLAGE OPERATIONS.

The land should be ploughed at least four times and the soil thoroughly pulverised by passing over it the "Plank roller" (Samar) after each ploughing.

MANURE.

Well-rotted old farm-yard manure (from cows, buffaloes, goats, &c.) may be applied, if available before the last ploughing or last but one.

RIDGING.

The land must be thrown into ridges exactly as in the case of

tobacco. This can be done by means of the indigenous plough. For this purpose a small board or a quantity of "Kubi" may be fixed into the angle of the plough. The distance between two consecutive ridges should be four feet and the ridges should run in a north to south direction, if possible.

Making Beds.

The field is then to be divided into rectangular blocks for the purpose of irrigation, as is done in the case of tobacco. This is to be accomplished by making ...about 30 yds. apart) at ...gles to the former set of ... means of an indigenous ... as before. The block will ... 30 yds. wide and may ... length up to 100 yds. ...e middle of each block, a small lateral canal (3 ft. wide) is made. Each half of the block is then divided into beds, each containing 5 rows so that when water flows into a bed it can irrigate all furrows in that bed.

Sowing.

This must be done by hand late in February or as early in March as possible. Boys may be employed, with a man to superintend the work. Each boy is given a quantity of about 2 lbs. of seed. The seeds should be buried about 2 inches deep, and this can be easily done by the boy forcing into the soil the fingers between which he holds the seed and on withdrawing his hand, scratching a little of the surrounding soil on to them. About 2 lbs. of seeds are required to sow an acre.

Watering.

The first watering is given immediately after sowing. This requires very great care.

Thinning.

About 40 days after sowing, the plants should be thinned, that is, all plants but two are removed by the hand from every hill or group where 5 seeds were originally sown. Immediately after thinning, the second watering should be given. One man can attend to the watering of about 4 acres per day.

Number of Waterings to be given.

The first watering is given immediately after sowing. The second watering is given immediately after thinning. The period that should elapse between sowing and thinning can best be judged from the appearance of the plant. The thinning and second watering should take place when the leaves of the plants begin to assume a light green or yellow color. In any case, at least 35 days must be allowed to pass after the seed was sown. If the plants are

watered sooner than this, the final yield of cotton and its quality will be unfavourably affected, though the plants may appear to grow better. The third watering should be given 15 to 20 days after the second and the crop must afterwards be watered at intervals of 15 or 20 days, until the picking of the cotton is completed. In every watering the water should be allowed to run into a bed until it has reached half way up the ridge.

AFTER-TILLAGE OR INTER-CULTURE

After each of the first four waterings the soil should be hand-hoed. This must be done as soon as the soil is capable of being worked without sticking to the implement (Kodar) say, 3 days after watering, except in the case of the very first watering, when 20 days should elapse before hoeing. At this hoeing "blanks" may be filled by placing 5 seeds in the places where seeds failed to germinate, In doing this the dry surface soil must be removed with a hoe until the damp soil below is reached.

The above instructions are more or less tentative and may be later altered and possibly simplified in detail after more extended and decisive experiments as to the time of sowing and intervals between successive watering, &c, best suited for the conditions in Sindh, have been carried to us by the Agricultural Department.

(Sd.) F. FLETCHER M.A., B. Sc., &c.
Dy. Director of Agriculture,
Bombay Presidency.

HYBRIDISATION—OR A NEW ERA IN COTTON.

Cotton can be greatly improved by hybridising with better seed.

The possibilities of Caravonica cotton, a hybrid raised by an Italian horticulturist, named Dr. D. Thomatis on his estate near Cairns in North Queensland, are just now arousing the attention of the whole world. The ties of tree cotton which are receiving most atten the north of India, are grown, according to the i tion recently published F. G. Sly, Officiating Ins General of Agriculture in India, from Brazilian, Peruvian, and indigenous seed. Much is hoped for from this cultivation, which, it is believed can be profitably carried on in quite poor soil. Though the first year's trial is said to be promising enough to justify the continuance of the experiments, some time must elapse before sufficiently definite results will be secured to decide what chances of profit these tree cottons hold out to investors. If, however, the success of the experi-

ments carried out in North Queensland is any criterion, the tree cotton for India *par excellence* would appear to be Dr. Thomatis' Caravonica cotton or rather cottons, for he has two of them. One point about the cotton plant, writes the "Madras Mail," which makes this supposition not improbable, is that all its numerous families show great adaptability to circumstances. In countries which are frost-bound in winter cotton is cultivated as a herbaceous annual, and its life ends with the year ; in some tropical countries it is grown as a perennial shrub, while in others it attains ...ity of a tree. Caravonica Dr. Thomatis claims to be ...g of tree cottons, and one ...est points is its extreme ...ss, another is that it does ...a tropical region which has ...stinct seasons—a wet and a dry one. This leads one to think that it would thrive, if not in all at any rate in many parts of this Presidency.

As stated above, Dr. Thomatis has produced two varieties of Caravonica tree cotton, both of which combine length, strength, and fineness of staple with a heavy yield. The one which he calls "Caravonica I" is a wool cotton, and is not only valued considerably above the produce of America, Egypt, and India, but also exceeds the yields per acre of cotton grown in those countries. Dr. Thomatis claims that this variety has given the surprising yield of 1,200 lbs. of ginned cotton per acre. Being a perennial it is cultivated much the same as an orchard tree. Each tree yields from 300 to 500 balls in a season, and these balls are so large that 70 will make 1 lb.

This variety is the result of a cross, not between Peruvian and Queensland varieties, but between the "Sea Island" cotton of Mexico and that of Peru. The issue of this union is said to be larger and stronger than either of the parents, with a tendency to flower all the year round. Dr. Thomatis checked this riotous behaviour by destroying the blossoms which appeared in the rainy months and encouraging the growth of those which appeared in the dry months. In every acre he plants 900 trees, each of which, he says, produces from 1⅓ to 2⅓ lbs. of clean cotton lint. Each lb. of this lint is worth, he claims, 10d. and the net profit, after employing white labour for picking, and paying wages at 8s. per day, works out at from £30 to £40 per acre.

"Caravonica II" was obtained by hybridising the "Caravonica I" variety with Kidney cotton from Peru. It is a silk cotton and its produce is of even greater worth than that described above, being valued at 1s. per lb. It is said to have a sheen and texture resem-

bling those of silk. It is not clear, however, what the annual yield of this variety is per acre ; and it must be noted that Dr. Thomatis considers the woolly cotton, *i.e.*, the "Caravonica I" variety, the more valuable for general purposes in India. A great advantage about both these varieties, as compared with other tree cottons, is that they bear their first crop—a small one—when only six months of age, and that they reach maturity when two years old, attaining then the size of an orange tree. They require no culture after the first year ; "only," Dr. Thomatis writes, "removing grass and pruning trees so as to rejuvenesce them. The pruning has to be done judiciously, just after the crop is over and on the eve of rainy season" and, he adds, "of course you want the proper soil to get large crops." In Queensland the future of these wonderful tree cottons seems to have advanced beyond the experimental stage. As a Cairns paper puts it, if even a half or a quarter of this sanguine estimate can be realised on the bulk of Queensland cotton lands, there are dazzling prospects before the States. The cultivation seems to be limited there only by labour difficulties ; and these under the present legislation are extremely acute. In India, where there is labour in abundance, Caravonica, if it will grow, should prove a blessing indeed. It is being tried, among other places, in Upper Shillong, but the results of the experiments have not yet been made known. It has also attracted attention in Ceylon where two planters are said to be going in for 1000 acres each. Orders for seed have also been received by Dr. Thomatis from Burma, Siam, Egypt, and Texas, that for the last named destination being "enough to sow 50,000 acres." The demand for the seed is, therefore, immense.

PROSPECTS IN INDIA.

As regards the possibilit[y of] Caravonica cotton in india t[he fol]lowing extracts from Dr. Tho[matis] dated Caravonica, Cairns, the [...] January, 1905, will be read [with] interest:—"In my opinion [there] should be no need for more e[xperi]menting, and I am confident my tree cotton (especially "No. 1" wool cotton) will do well in South India, as it is doing splendidly already in Ceylon. I am certain it will be the best money crop and the surest, so that it will bring every year the money to meet the disastrous periodical fail ures owing to droughts of all your annual cereal crops, and then all Indian famines will be averted from the hundreds of millions of our fellow Indian subjects. I want all India and Burma to grow the

Caravonica cotton; it will enrich the millions of people and agriculturists; its crop is annually from £60 to £50 per acre nett, and more if properly cultivated with abundance of labour as you have. The crop is sure. Floods will benefit the trees, and drought will also be good, because the crop will be more perfect during drought. You will just let me, know the time of your dry months of drought, and I shall direct the Caravonica growers how to handle the trees. I can make, by a special treatment the trees bring the crop exactly during dry months and put on wood and bran-luring the wet season. With unlimited available native r you have, the capabilities of 'onica tree cotton in India are nse and untold, impossible to :alculate. I could get 4s. per r with 900 trees to the acre, I et £200 per acre annually."

Caveat emptor, some may say; and indeed this glowing description might be largely discounted by the natural enthusiasm of the discoverer for his discovery, or of one who had an eye to business in selling seed. But Dr. Thomatis quotes the opinions of several authorities in support of his assertions. The Associated Spinners in Italy, Hungary and Germany, have, he says, declared the Caravonica "better than the best of American cottons," and they expressed their willingness to "buy all that can be grown at double current price." Leading Liverpool cotton brokers said:—If grown largely, Caravonica cotton will open a new era in cotton culture;" and they valued it at 10d. per lb. The Minister of Agriculture in France pronounced it "a valuable substitute for wool." The Curator of the Botanical Gardens at Port Darwin, North Australia, wrote—'I can only describe it as prodigious, and such a prolific variety may solve the labour difficulty." In a whole sheet of Australian papers, which Dr. Thomatis has sent us, similar opinions are recorded. A splendid exhibit of Caravonica cotton was on view at the Royal Agricultural Society's Show held at Melbourne last year, and it was described in a Melbourne paper as "an historical exhibit." Earlier in the year a paper by Dr. Thomatis, describing his new discovery and his experiments with it, was read before a meeting of the above Society, and elicited an interesting discussion among visitors from all parts of Australia. We learn also that a cotton expert, by name Mr. Bottomley, was much impressed with the Caravonica varieties, and that he has prepared a report on it for the British Cotton Growing Association.

It only remains to be said that Dr. Thomatis is offering seed of the "Caravonica 1" variety at 10s.

per lb. and of "Caravonica II" at 21s. per lb.; that 1 lb. contains 2,000 seeds, which is enough for two acres; and that a discount of 25 per cent. is allowed on orders of 50 lbs. and upwards. For the benefit of those who wish to experiment, however, we understand that the Madras Agri-Horticultural Society has obtained a small supply of seed whence it can be obtained on application. Whether Dr. Thomatis' predictions as regards the success of Caravonica cotton in South India will be realised remains to be proved; but it will be admitted that a plant, the introduction of which might mean so much to India is well worthy of trial in all parts and we commend it to the notice of Government Farms, District Agricultural Associations, Zemindars, Planters and others.

SOME PRACTICAL HINTS FOR THE CULTIVATION OF EGYPTIAN COTTON.

(By Mr. Srinath Dutt, Assistant Manager, Hathwa State, Saran).

It appears to me from a letter received from the Deputy Director of Agriculture that Egyptian cotton "will not succeed in districts with excessive and uncertain rainfall." So it should not be tried in North, East and Central Bengal. But in the Burdwan Division, Orissa, Chota-nagpur, and Behar, where rainfall is not excessive and well irrigation and tank irrigation are resorted to, cultivation of cotton with Egyptian seed should be tried. It may be tried on lands that have hitherto grown potatoes, brinjals, banana, cabbages, etc.

Persons who have no experience of cotton cultivation should visit Mourvanja, Pusa, Nagpur and Dharwar (Poona). Cultivation, like weaving, can not be learnt from books.

The following letter from Mr. Fletcher, Deputy Director of Agriculture, Bombay, who has the credit of having introduced the cultivation of Egyptian Cotto[n] Sind will be interesting t[o] readers:—

The seed of the Egy[ptian] variety should be sown in [rows] 3 feet apart and at distanc[e] one foot between the plant[s in] the rows.

Sowing must be done by hand late in February or as early in March as possible. Part of the seed may also be sown in June and a few in October. After-cultivations should be as in the accompanying instructions for sowing. It will be necessary for you to make ridges before sowing unless you irrigate at that time in a dry season. The operation of hoeing will result in the formation of ridges.

Mr. D. N. Mukerjee, Assistant Director of Agriculture, has in an article on Cotton Cultiv[ation]

ublished in the *Banga Darsan* ointed out that for Photi cotton rom which muslin yarn used to e spun and which used to be ultivated in the north and east f Dacca, there were two seasons or sowing and harvesting—(*i*) sowng in April and harvesting in November and (*ii*) sowing in October or November and harvestng in April or May. Cotton harvested in April was considered uperior. As we have no frost n Bengal, the seasons mentioned y Mr. Mukerjee may suit Egypian cotton better. In Sind and upcountry, the frosty winter has to e avoided. In Bengal sowing ultivation should be so regu- (as suggested by Mr. N. G. rjee) that plants may not during the rainy months of to October. Everything cultivation of Egyptian cot- is still in an experimental stage.

Persons wanting Egyptian seed hould apply to F. Fletcher, Esq., M. A. (Cantab), Deputy Director of Agriculture, Surat Bombay.

In a letter, recently published, 'M. B." who unfortunately does not say whether he has tried as yet any cotton in his gardens or zeminderies, points out what he conceives to be an inconsistency n my letters on the subject noted above. Mr. Fletcher has introduced the cultivation of Egyptian cotton into Sindh whose climatic conditions with 3 or 4 inches of annual rainfall and facilities of irrigation resemble those of Egypt very much. While he expressed a fear that it might not do under excessive or uncertain rainfall, he said that the matter was at an experimental stage, and therefore advised sowing in February or March (probably after potato or sugarcane has been harvested) and also in June.

It is only experiments in all districts of Bengal and in all seasons that can settle the question. In the rotation of crops, cotton may follow jute, in which case it will ripen in April and May, or it may follow potato or sugarcane, in which case it will ripen in November. Every Zeminder worth the name may afford a bigha, and every person who calls himself a *bhadroloque* may spare a cottah in his kitchen garden, and thus in the course of a single season offer materials which will be more reliable than the published reports of the Government. My Egyptian seeds did not unfortunately germinate at all. But I found that the seedlings, reared from (1) tree cotton (2) Dharwar, (3) Boyd's Sea Island (4) Peruvian and (5) Caravonica seed, did not suffer at all from the excessive rainfall such as we had in last July, August and September in Saran District. I have therefore no reason to anticipate that Egyptian seedlings

will fare worse if the lands be well drained. I have not received as yet my supply of Egyptian seed, promised by the Deputy Director of Agriculture. It is my intention to sow in March and also in June and October. Cultivation must be so regulated as to enable the cultivator to harvest before frost weather or before the rains set in. In Bengal, we have no frost and it is therefore better off in one respect.

The Deputy Director of Agriculture, Bombay Government, has given the following opinion on a sample of Dharwar cotton, grown at Hathwa by Mr. Srinath Dutt, Assistant Manager of Hathwa Raj, Saran :—"With reference to his letter, to the Superintendent, Dharwar, submitted to me for opinion on the quality of fibre, the undersigned has the honour to inform Mr. Dutt that the sample of fibre is as long as the crop of the Dharwar district, but has become inferior in colour probably due to frost. The undersigned will be glad to see a sample of the fibre of the crop, sown last February. (Sd.) F. Fletcher, Deputy Director of Agriculture."

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timely suggestion.

REWARDS FOR COTTON CULTIVATION IN THE NATIONAL EXHIBITION.

(Mr. Srinath Dutt's Suggestion.)

"—There will be an Exhibition of industrial and agricultural products next December in connection with the National Congress. May I suggest the awards of prizes for the best cultivation of cotton in Bengal? Prizes may be confined for the present to the cultivation of (1) Egyptian and (2) Dharwar or Broach cotton. There may be one set of prize for each district. The members of the Bar Library of the District courts with as many Zeminders as may choose to join direct, besides being represented by their Vakils, may form a District Committee. There should be at least two prizes for each kind of cotton, the first prize, of Rs. 100 and the second, of Rs 50. Th competitors should cultiva least one bigha of land with c If they sow before May, th will be ready for local insp in November and for exhi in December. The more mc District Committee may rais larger and more numerous may be the prizes for the District. It is quite possible that if the Government be appealed to they may contribute as much as is raised by voluntary subscription. Award of these prizes may be advertized and notified in vernacular papers or by circulars, distributed through village panchayets.

The prizes should be so large as to entice people to run the risk of forfeiting a paying crop like jute. A cultivator likely gets Rs. 30 or Rs. 40 from the jute crop of a

ear. If that prizes be Rs. 100 for biggah of cotton, he may consi- er it worth his trouble to put a milar area under the prize crop. n this way a single year will settle ie question whether cotton culti- ation may not be revived in ;engal. If the old *photi* variety as become extinct, the Sea Island 'ill under proper care become as cclimatised in Bengal as it has een in Egypt. If we try Egypt- an or improved Sea Island, our abour will be one step easier than hat of the pioneers of cotton cul- ivation in Egypt."

BOOKS ON PRACTICAL)TTON CULTIVATION.

tton cultivation is as simple ltivation of brinjal or cayenne. kamarich). Mr. D. N. Mooker- Assistant Director, has pub- d in Bengali a book and Babu iran Choudhry, another. They may be had from the Agricultural Department of Bengal. Mr. N. G. Mookerjee, Assistant Director of Agriculture, Bengal and Mr. F. Fletcher, Deputy Director of Agriculture, Bombay, have published Instructions on the Cultivation of Cotton. These may be had free by applying to them. Wilkinson's "Story of Cotton Plants," and "Royle's Cultivation of Cotton in India" may be consulted.

Raja Peary Mohan Mukerjee's 'Note on cotton cultivation,' and 'Note on cotton in Behar' dealing with the researches at the Pusa Agricultural Institute, by Mr. Lefroy Government Entomologist will also be found of interest.

A NEW VARIETY OF INDIAN COTTON.

Mr. J. R. Spence writes from Deesa in the Statesmen :—

It is a fact well known to commercial circles in this country that the deterioration in the staple of its raw cotton during the past twenty or thiry years has given rise to the gravest anxiety. It is greatly feared that if this deterioration continues in the same proportion the chief product of India's soil will ultimately prove useless, even for the low quality of yarn and cloth at present produced in her mills. It has, therefore, become commercially the burning question of the day how to produce a long-stapled cotton, which may be universally grown in place of the very inferior varieties which are now raised. This has been spoken of as the "Philosopher's Stone of Indian Agriculture," and the news will be warmly welcomed througout the land that this precious stone has at length been found.

I have had the good fortune to discover that there exists a tree, practically indigenous, at present growing in various parts of the Bombay and Madras Presidencies

which produces a cotton infinitely superior both in classification and staple to American cotton, and which in classification alone cannot be equalled in Egypt. It is an astonishing fact that the value of this tree's product has not up to this time been discovered by any one in the cotton trade, notwithstanding the fact that the tree has been known to exist since the time of the Mutiny, and probably for hundreds of years previously. The only uses to which the cotton it produces has so far been put are the manufacture of wicks for lamps in Hindu temples and the stuffing of beds and pillows.

I first saw the tree in a friend's garden at Deesa, and on examining the cotton obtained from it at once recognised its great value, and set to work to obtain information in the neighbourhood with regard to its origin. I found there were a number of similar trees in other gardens, and that a few miles from the town there was a large hedge entirely composed of them, from which I was able to procure a large sample of cotton. After carefully examining it I unhesitatingly expressed the opinion that it possibly would ultimately revolutionise the cotton cultivation of India. I then sent samples to Bombay and Liverpool, where experts in the former city classed it as "Fine" white in colour, staple $1\frac{1}{4}$ to $1\frac{1}{2}$ inches long, and said it would spin up to 60*s.*—in the latter city it was classed "Superfine" colour white, staple $1\frac{3}{16}$ to $1\frac{1}{4}$ inches in length, and valued at 7*s.* 8*d.* per lb. above the price of "middling" American. I then decided to undertake the cultivation of the tree on a large scale, bought up the available seed, and made arrangements to procure all grown in the neighbourhood in the future.

There is now considerably over a lakh of trees on this plantation in a most flourishing condition, growing to a height of from four to five and a-half feet, full of buds and bolls, and bearing cotton daily after being planted only months. The quality of the crop" 1906 cotton is superior in classification and staple to of the parent tree. The yi the first year has been estin by experts at a minimum amount of 2 to 4 ozs. per tree, and as there will be over 3,200 tree to the acre this gives a total yield of 400 to 800 lb. per acre, which is above the average of Egypt and no less than from eight to sixteen times greater than the average of all India. The second year's crop will probably be double the first, and the third year's double the second. Each succeeding crop will no doubt increase still further, as it is well known that trees of this variety after the third year have yielded 5 to 10 lbs. of clean cotton

r tree annually, during a known e of twenty years and over. It ill thus be seen that if one-third the cotton-growing area of India ere planted with this tree, the sult of the second year would a crop far in excess of that of is country and America put gether. The quality is so ex-lent that it opens an entirely w field for Indian manufactures, e importance of which, bearing greatly as it does upon the ture prosperity of the country, nnot be overestimated.

I was formerly for twenty years member of the Liverpool Cotton roker's Association, and have ve years, experience of cotton ng in Egypt. This cotton een called. "Spence Cotton" cognition of the fact that I he first to discover its im-tant value and to bring it to e notice of the commercial com-unity.

Several cotton trees have been ied in this country, notably those om Peru and Brazil, but the rst will not grow in the planes at l, and the latter has not been und pratically suitable to the limate. The great advantage and nportance of the "Spence Cot-on" tree is that it is practically ndigenous, that it has been found ll over Western India, and no loubt exists in the East, and that t will grow and flourish practi-ally in any soil in this country.

AMERICAN COTTON IN INDIA.

It is not only in Sind that experiments are being made to popularise the growth of long staple cotton by the Indian cultivator. It is officially stated that the acclimatisation of American varieties shows some promise of success about Cawnpore, and similar results are reported from the Punjab. There are the experiments with tree cottons in Behar by private enterprise assisted by a Government subsidy; and in the Central Provinces the deterioration of acclimatised American plants is sought to be arrested by cross-breeding with fresh varieties imported from the United States. There is activity in experiment all round, and at the same time efforts are being made to improve indigenous cottons by the distribution of selected seed and by hybridisation. The establishment of more cotton farms has been undertaken, and one of these will be in the irrigation colonies of the Punjab, where the growth of exotics will be specially tried. The success gained with Egyptian cotton in Sind has been so remarkable that there is every encouragement to proceed with experiments in the various Provinces.

COTTON GROWING IN CEYLON.

Messrs. Nieland and Wilson some time ago offered to supply any Ceylon planter willing to experiment in cotton-growing with the best cotton seed free of charge. They also undertook to give Planters all the information on the subject they required. This sporting offer attracted wide-spread attention in the Island, and we hear that Sea Island cotton seed sufficient to plant up 3,000 acres has been applied for, and is expected to arrive in August next, which is the best month for planting it. Three thousand acres, the "Times of Ceylon" says, means 3,000 bales, and taking a bale at 500 lbs. net and 1lb. of cotton grown in Ceylon to be worth about 9d. landed at Liverpool, the commercial value works out roughly at £30,000. Ceylon cotton fetched this price at Liverpool a year ago, i.e., 3d. above the average of American cotton, and Mr. E. W. Nieland, senior partner of the firm, who has been eight years in the Indian cotton trade, has valued samples of this season's cotton crop in Ceylon at 9½d. per lb. He also recently valued samples of Georgia cotton and Caravonica cotton, grown at Betticaloa in Ceylon at 7½d. per lb. and 8d. per lb. respectively, landed at Liverpool. The prospects of cotton growing in Ceylon in suitable places (and it must be remembered that cotton will not be successful in places with more than 75 inches of rain) and provided planters stick to pure seed appear, therefore, to be very good; and there seems to be every prospect of the industry develoning in the way that the Governor H. E. Sir Henry Blake, said at the last meeting of the Ceylon Agricultural Society that he hoped and believed it would.

GOVERNMENT REPORT ON COTTON EXPERIMENTS IN BEHAR.

Mr. Mollison, Inspector-Ge[neral] of Agriculture, has prepare[d] the Lieutenant-Governor's re[quest] the following note, showin[g] results of recent experimen[ts] cotton, the experiments he in[tends] now to carry out, and the arr[ange]ments he has made to supply to these planters and cultivators who are willing to co-operate with him in this important work. The Lieutenant-Governor has had the note printed for circulation in the hope that Mr. Mollison may secure much valuable assistance from the co-operation he desires.

Mr. Mollison's note is as follows :—

Certain experiments with exotic and indigenous varieties have been in progress in Bihar during the last two years, and sufficient is known regarding the behaviour

of each of the varieties which were tried to determine, within limits, which should be most extensively cultivated. The following notes describe the general results to date and the line of experiment which I propose for the current season. Free criticism from planters or others will be most acceptable.

The varieties which have been tried are—

(*a*) Egyptian varieties ;

(*b*) Peruvian varieties ;

(*c*) American varieties of the upland type which have been acclimatized in India for a good many years ;

American varieties of the type which have recently introduced ;

A few indigenous varieties Broach or Surat type.

Mollison goes on to ob- :—I am at present of opinion n small areas where seed can be sown with irrigation early in May, it is probable that Egyptian varieties which ripen late in India may be profitably grown; but if the sowing of these varieties is deferred until the rains in June-July, they will not grow so well as the earlier crop with irrigation, and are likely to be damaged by cold or frost in December-January before they begin to yield freely. The lint obtained from plants grown from newly-imported seed is long and fine, but generally is discoloured to a considerable extent by bollworm. The Peruvian varieties which have been tried ripen later than Egyptian, and are therefore less suitable for Bihar.

The American varieties of the upland type acclimatized, and newly imported, ripen much sooner than the Egyptian or Peruvian varieties, and many of these, if sown in India, will escape the risk of damage by cold or frost in December. About 40 of these varieties have been tried. There is clear evidence that—

(*a*) acclimatized varieties in Bihar are less risky in an unfavourable year than newly-imported varieties of the same class, and are probably more productive in a normal season ;

(*b*) that the produce from acclimatized varieties is not greater, and the lint not much better, than from the best indigenous varieties of the Broach type ;

(*c*) that some newly-imported varieties come to maturity quicker than others, and some are more productive and less risky to grow in an unfavourable season ;

(*d*) that the lint obtained this year (a bad season) from each particular variety was variable in character, this being due to irregular growth of plants. The weakly plants produced bolls which ripened prematurely and gave shrivelled seed and defective lint. The damage done by boll-worm was considerable as is usual in cotton

crops which have not grown vigorously. Bolls which did not open prematurely gave cotton of exceptionally fine quality in the case of many varieties.

It is possible that superior, late-ripening, indigenous varieties, such as the "deshi" variety of Broach may, on account of the risks of cold and frost, be as unsuitable for Bihar as the Egyptian and Peruvian varieties. There is some evidence, however, that these indigenous varieties are not so seriously affected in Bihar by cold as exotics, and probably can, in an ordinary season, be grown without risk, and at a profit without irrigation. Certain varieties of this type have grown well in 1902-1903 and 1903-1904 and the lint which has been produced is alike suitable for Indian mills and for Manchester.

I cannot say anything very definite as regards deteriorating effect of acclimatization on newly-imported exotics. I believe that they will be improved in vigour of growth by acclimatization and that deterioration may be arrested by cross-breeding. These are points, however, for my Department to investigate and need not at present affect issues as far as the [illegible] planter or the ordinary cultivator is concerned.

Experiments have proved that we can now deal in the field with much fewer varieties than were dealt with in the experimental plots. I have watched these experiments closely, and can say that it is necessary to arrange for Bihar for considerable quantities of seed of certain exotic and indigenous varieties.

It has been proved that two or three acclimatized varieties of the American upland type are worthy of extensive trials in Bihar, and also that indigenous varieties of the Broach type are equally promising. I have therefore arranged for considerable quantities of seed and made special arrangements to collect seed true to variety. I believe that two of the n[illegible] imported American varietie[illegible] likely to be more succes[illegible] grown than the other vari[illegible] These two varieties are *A[illegible] Hybrid* and *King's Imported*. I have ordered 2½ tons of [illegible] I have ordered in the aggregate 2,500 lbs. of 17 other American upland varieties, all of which have already been experimentally tried. I have also arranged for 500 lbs. of each of three Egyptian varieties (Abassi, Mutafifi, and Yannovitch), and about 3 tons of seed of acclimatized American varieties, and of indigenous varieties of the Broach type.

The seed above referred to are intended for various parts of India, but chiefly for Bihar, the Panjab, and Sind. It will be sufficient to sow a large area, as 7lbs. of good

seed per acre is sufficient. There is in my opinion great scope for extending the cultivation of superior cotton in these districts. A good deal of seed has last season been produced on Government farms and by planters in Bihar and cultivators elsewhere; but it is only natural to suppose that the seed of such varieties as have been proved most successful will be used for extended local cultivation in the Provinces concerned, and only trifling quantities for small experiments will be available for general distribution by my Department.

vill arrange at Pusa in the g season for extensive cotton ments—

in comparing varieties,

in testing methods of culti-
),

in proving varieties by selection and cross-breeding.

I am also arranging for cotton gins (manual and power machines) which will deal effectively with indigenous as well as exotic varieties.

In my opinion neither good indigenous, nor good exotic varieties of cotton can be successfully grown in Bihar, unless the common method of sowing cotton subordinate to *makai* (maize) and *arhar* (tuer) is modified. It is possible that superior varieties can be grown as a mixed crop with maize; but *arhar*, which grows into a strong, tall, much-branched plant in Bihar, would smother any good variety of cotton. If cotton and *makai* are grown together, the seed of each crop should be sown in seperate rows—two rows of *makai* alternating with one row of cotton. This can be easily done by a three-coulter drill which is commonly used in any good cotton district in India. Last year's Bihar experiments indicated that the maize in the mixed crop had a protective effect in shading the young cotton plants. At Arrowah (Chapra) the maize was worth Rs. 18 per bigha, and coming soon to maturity was removed sufficiently early to allow the cotton plants to branch out afterwards. The rows of cotton, when the maize was removed, were two feet apart; and I recommend this distance as suita for the American varieties. ind plants should be thinned out to 15 inches to 21 inches apart in rows in the case of a healthy vigorous crop. It is important that the rows or mixed crop should be bullock-hoed, and when the maize is removed, the space between the rows of cotton again intercultured. The ordinary indigenous implement used in a good cotton district did excellent work last year.

In 1903 I arranged for experiments in Bihar in sowing and cultivation on the lines referred to in the last paragraph. It is necessary to have expert cotton

cultivators to do the work; also trained bullocks and the necessary implements. One pair of bullocks dealt with about 40 acres last year. I can provide this year from Pusa as a centre, 5 pairs of bullocks, a trained man in charge of each pair, the implements required, and a fieldman from my office to supervise the work. I should like to deal with 5 or 10 bighas on each indigo concern within reach, provided the selected areas are grouped near to each other so that one pair of bullocks can sow expeditiously about 30 bighas altogether. The land must be of fair average quality and as carefully prepared as for *makai*, but should get no special treatment in the way of manuring or otherwise. The object of these trials is to determine whether cotton of superior quality can be grown profitably on extensive areas under conditions of cultivation which can be ordinarily arranged for.

I do not believe that the cultivation of cotton will extend in Bihar unless planters can, through their tenants, arrange to grow the crop under a share-system or some other system. The difficulty in the way of actual cultivation by planters themselves is chiefly on account of losses by theft which would be considerable or great, there being 900 or more people to a square mile.

An opinion prevails that certain perennial varieties of cotton which are known to produce very fine lint can be profitably cultivated on extensive areas. I should advise caution over this scheme. The insect enemies of cotton are very numerous, and even in annual crops, where the same area is not occupied perhaps oftener than once in three years, it is extremely difficult to prevent considerable damage by boll-worm, and judging by the damage done by this pest to the produce of perennial trees as ordinarily grown, I would expect very serious damage to occur in large plantations. tion unquestionably reduc of loss. Mr. Lefroy, the E logist of my Departmen taken up the study of insect affecting cotton in India, an before next season be ab recommend practical re measures which will keep in check.

EXPERIMENTS IN CEYLON.

DR. J. C. WILLIS, Director of the Royal Botanic Department, Ceylon, gave a very practical illustration on Monday last at the Ceylon Board of Agriculture meeting, of what has repeatedly occurred in Ceylon, and always will occur again and again, says the *Ceylon Observer*, as long as the industry of cotton, or any other similar planting product, is in the

hands of natives. He "showed five typical samples of cotton grown by natives. The specimens were the best kind of cotton, Sea Island; and these were taken at random from a small lot the best native-grown cotton produced in the Island of late years. Instead of having a staple of 2¼ inches in length, not one of these samples was more than one inch, and most of the lot was of a staple less than half an inch in length. And this deterioration from the original Sea Island cotton, imported into Ceylon from the west [illegible] had taken place in only [illegible] generations—purely the re[illegible] want of seed selection. Any [illegible] good enough for the native [illegible]r. No one can convince [illegible] the need of selecting only [illegible]st seed for sowing purposes; centuries of paddy growing [illegible] not select his paddy seed, so that he certainly will not do it in cotton-growing. The only way to really establish cotton-growing in Ceylon on a firm basis, is to induce Europeans to take it up."

EXPERIMENTS IN THE GOVERNMENT GARDEN AT SAHARANPUR.

Last year *experiments* were carried on in the Government Botanical Garden at Saharanpur in *growing various kinds of Egyptian and American cotton.* The Economic Botanist to the Government of the United Provinces now states that in all cases the yield was very much below that of the indigenous kinds, "but reports on the quality of the staple as most encouraging." Mr. Leake states that there is no intrinsic difficulty in growing exotic varieties of cotton in India. The matter was settled as far back as 1850. But economic difficulties in the way of inducing the Indian cultivator to adopt new varieties are many. He probably realises that the increased value of the crop will not reach him. The question of the abundant manure required by the Egyptian and American cottons is another difficulty in the way.

SUCCESSFUL CULTIVATION IN THE BOMBAY PRESIDENCY AND ELSEWHERE IN INDIA.

The Bombay authorities are apparently confident of the success of Egyptian cotton in Sind where so far experiments have been quite promising. About 10 tons of seed were imported and distributed in 1904-05 with the result that the yield was very satisfactory in quantity and in staple and very good valuations were received of samples of the fibre from Messrs. Wolstenholme and Holland of Liverpool.

Messrs. Ralli Bros., and Messrs. Volkart Brothers of Karachi. The Egyptian cottons, which have proved most successful in growth in Sindh, are the Abassi and the Mitaffiffi, and it is stated as remarkable that while the local indigenous variety suffered severly from attacks of boll-worm, the imported Egyptian varieties were almost immune. The official view is that if the cultivation continues as equally successful as in the past two years, the matter may be said to have left the region of experiment, and an outturn of not less than 100,000 bales may be expected in the course of a few years.

Cotton Cultivation in Madras.—An important move in connection with the improvement of cotton cultivation in the Madras Presidency is the distribution of pure seed to the cultivator in certain selected districts. Enquiries made in connection with the results of the distribution made in the seasons of 1905-06 show that the crop grown with pure seed as was sold, yielded more than the ordinary seed and gave a higher percentage of lint than the ordinary cotton and that the advantages of sowing the selected seed are now fully appreciated by the ryots. The authorities are also working direct with the cotton growers to abandon the admixture of cottons on the Vandyol Valley and for the season of 1906 offered a premium of two annas per acre for every acre of practically pure cotton grown within certain areas of the Kurnool and Cuddappah districts. Claims for premium were prefered in respect of about 13,000 acres of which about 2,00 acres were on investigation found elligible for the reward. The ryots who understand the value of the incentive offered to grow pure cotton have been strongly advised by the authorities to keep their pure cotton seed for future cultivation and to take care not to allow it to get mixe with impure varieties. ments in crossing cottons being carried out by the P of Biology at the Madra dency College (Mr. Fyson) view to making a scientifi of the subject.

World's Cotton Supply.—The Commission appointed by a number of the leading cotton firms of Lancashire to visit the cotton growing area of America, makes some important recommendations in a report just issued. Europe pays the planters of South America about £200,000 a day for cotton, and the Commissioners found that there is, in the southern portion of the United State, enough suitable land to produce all the cotton the world will require for years to come. While the cost of manufacturing the fibre has been enor

mously reduced during the last fifty years, the cost of producing it has not altered, and the planters are using exactly the same imple- ments and machinery as were employed by their grand-fathers. Just at present, a wave of un- exampled prosperity is sweeping over the Southern States, the high price of cotton having placed the planters in a position of inde- pendence. In 1880 the value of the American crop was only £62,739,000, as compared with £78,000,000 in 1890 and £136,000,000 in 1905. In addi- tion, the farmers would now be raise money on other crops cotton fall below a remu- price. The Commission these facts as constituting, e efforts of the Cotton s Association to control s, a problem in the solution ch Great Britain will have to exercise the greatest care.

EXPERIMENTS IN MYSORE.

A South Mysore correspondent writes:—Under the aupices of Mr. Norton, Messrs. Binny & Co. are making a bold experiment with cotton at Hoolhully, which was once one of the finest coffee estates in the district. Mr. Norton has already planted out 60,coo cotton plants.

CULTIVATION IN CENTRAL PROVINCES.

The cultivation of cotton throughout India is extending in every direction, and the record price of 10d. per pound obtained for Sind-grown cotton from Egyp- tian seed will still further increase the popularity of this crop in all suitable localities. The Revenue Report of the Central Provinces is full of references to this exten- sion of cultivation, the rise in price of cotton for many years having been so good. In the year 1905 the increase of area sown in the above Provinces amounted to 224,000 acres, and of this 53,000 acres occurred in districts in which until recently, the crop was of little importance. In one district in Wardha, an enterprising mal- guzar has been most successful with cotton from American seed while in the cotton tracts of the Nagpur Division the proprietors are increasing their cultivation as much as they can.

THE INDIAN TREE COTTON.

For thousands of years the tree cotton (*Gossypium Religiosum*) has been an indigenous plant of India and its cotton was known to every one in the country.

This is the only long staple cotton obtainable in India and ich is in no way inferior to the

best cotton in the world. It is greatly to be regretted that no Indian firm has yet been started with sufficient capital to start its cultivation. . . .

It is a most wonderful thing that when we have amongst us an indigenous kind of cotton which is equal to the best cotton in the world, we have been making all sorts of fruitless experiments to grow here a foreign species. This cotton has again an especial value in as much as the plant will last about 5 years whereas other species have to be grown every year.

Messrs. Shaw Wallace & Co., are reported to have acquired large tracts of land in Bengal and other provinces of India for the cultivation of long-staple cotton. It is further reported that they would, amongst other kinds of cotton, give a fair trial to the *Indian Tree cotton* (*gossypium religiosum*).

TREE COTTON IN THE BOMBAY PRESIDENCY.

Experiments to demonstrate the suitability of Peruvian cotton for cultivation in large areas in the forests of the Karnatak Ghats in the Bombay Presidency are in progress. They have been initiated at the suggestion of a European gentleman of Belgaum, who has been successful in growing this variety of tree cotton for several years. The Government have made a grant towards the cost of the experiments which, however, have not been successful in the first year owing to an unfavourable monsoon season in that part of the country. Good results have been obtained in the Bombay Presidency in the experiments to improve the existing local varieties of cotton by selection and hybridization. At Surat a considerable number of improved plants have been so obtained and it is hoped before long to begin the distribution of the seed produced on the farm there.

WHERE TO GET EGYP[TIAN] COTTON SEEDS FR[OM]

Allow me to point out growers of cotton in Benga[l] the seed should be freshest and [shou]ld be procured—(1) Dharwar ..... Broach varieties from the Superintendent of Dharwar, P. O. Dharwar, Deccan and (2) Egyptian variety, from the Divisional Inspector of Agriculture Sind, P. O. Mirpur Khas via Pachpadra, Sind.

I have tried seeds supplied by the Department of Agriculture, Bengal, and also those supplied by persons just named; and I have found that seeds from the latter have germinated better. A fort-

night ago I sowed 2 *katas* with Egyptian cotton seed, 4 in a hole, in trenches which are one foot deep and 3 feet apart. There is no place now without a seedling. This is the great advantage of getting the supply of seed first-hand from the growers.

I have found that the blossoms or flowers of the cotton cannot stand the frosty weather such as overtakes them in Behar and the Upper Provinces. The best thing with tree cotton in countries with frosty weather is to prune down ...nts in November or De... like tea plants. With the ... of spring (February and ... trees should begin to throw ... and (a fortnight later) ...s. This is what I have ...n Saran.

...eat that a revival of cotton ...ion in Bengal can be ... about if men with even moderate wealth, intelligence and education will devote a *kata* or two to the purpose. Ordinary cultivators have strong prejudice against trying any new crop lest it should bring any calamity.

If the land be properly drained like lands for cultivating potatoes and sugarcane, my experience is that cotton plant will stand any amount of rain. It may not be out of place to mention that (1) the Egyptian seed is black and clean (without any hair); (2) the Dharwar seed has a bluish color with hair on; (3) Broach has hair on with the natural color of cotton; (4) Peruvian seed and tree cotton seed are found clustered in kidney shape.

March 25, 1906. ŞRINATH DUTT.

Mr. N. C. Ghose, Superintendent, Model Farm, Mayurbhanj, State (P. O. Baripada) is in a position to give all particulars about, and supply seeds of, cotton so successfully grown there last year.

COTTON CULTIVATION IN BENGAL.

(*By Mr. Srinath Dutt, Hathwa, Saharan Bengal.*

Allow me to draw the attention of my countrymen, interested in the revival of cotton industries in general and of cotton cultivation in particular, to a highly interesting article on the cultivation of cotton in the Bombay Presidency, by Mr. F. Fletcher, B. Sc., Deputy Director of Agriculture, Bombay Government, in the October number of the Agricultural Journal of India.

To the officious mentor of our Agricultural classes the following may be offered for reflection and consideration.

"From the cultivator's point of view the value of a variety of

cotton—the plant in contradistinction to fibre depends on :—

(i) Yield per acre of seed cotton,

(ii) Price of Seed cotton,

(iii) Hardiness of the plants and

(iv) Method of ripening.

"The yield per acre is of the very greatest importance, but for purpose of deciding the question of the Superiority of one or other of two competing varieties, is indissolubly bound up with the question of the price of the produce.

The point can be settled only by actual experiment in the field. As an example we may quote the fine-stapled "Bani" of Hinganghat which has been largely displaced by the Coarser 'Jari' 'Vardi', and here it would appear that the producer and the consumer (or rather a particular class of consumer) may be anxious to proceed in opposite directions. Thus, the Lancashire spinner (or th Bengali 'Bhadro loque) would prefer that the finer 'Bani') should be grown since he can not use coarser 'Jari' while the cultivator may urge that the 'Jari' gives him a larger yield per acre, and that the price obtained from the worsted manufactures of Saxony (or cotton spinners of India) though not so high per maund as that obtained for 'Bani,' is such as to make the value per acre of 'Jari' greater than that of 'Bani',

It will be ten times easier for the upper classes at Bengal to change their habit of clothing themselves and their ladies in fine clothes than for the Indian cultivators to successfully compete with America and Egypt in growing long-stapled cotton or for the Indian cotton spinners in manufacturing superfine dhuties. If one remembers the deeprooted ignorance and illiteracy of the agricultural classes, which the better classes have done nothing during a century of British rule or before, to remove either by private chari'y or by seeking help of Government, any change in habit of tilling must be very s but in the present case it is their pecuniary interest tha habit of producing coarse should be changed at all. rapidity with which cultiv of jute, potatoes and cab have extended and apliances like the Behea Sugarcane Mill have been appreciated, should encourage even the pettiest land-lord in putting before his ryots experiments of cotton cultivation for their examination observation and (if profitable) acceptance.

The rainfall in the cotton districts of the Bombay Presidency from June to September during which time cotton is grown there as a kharip crop, is very near the rainfall we have from October to May in Bengal.

RAINFALL

District or tract	June to September	October to May	Time of sowing.
Broach / Surat	31·99	2·26	June.
Dharwar	20·49	13·02	Sept.
Belgaum	12·46	10·56	
Satara	15·44	9·71	June, July.
Bejapur	15·82	8·75	
Solapur	22·34	5·67	
(Madras)	9 1	8·05	
Ahmedabad	30·29	1·10	June.
Nadiad	36·27	1·28	
Kaira	31·62	1·11	
Dhanduka	25·86	2·02	

These figures are quoted from Mr. Fletcher's article. Rainfall in these parts of India is insuffi- to mature cotton as a rabi ɪut in Bengal Proper east : Hoogli and the Manas, the l in October to May is not han rainfall in these pro- from June to September. the suitability of growing as rabi crop in North; Central and East Bengal. This agrees with the result of inquiry as to the time when cotton used to be grown in the Dacca and neighbouring Districts.

Our countrymen ought to read Mr. Fletcher's article, the one or two quotations from which can hardly give an idea of its value.

IMPORTANT PRACTICAL HINT FOR THE TESTING OF COTTON SEED.

The following important note appears in the Agricultural Journal of India Vol I, Part II. (April 1906):—

"It is well-known that in some cases a considerable percentage of cotton seed fails to germinate after sowing. This failure is generally due to the sucking of the seeds by some of the cotton pests of which an account was given in the first number of this Journal. The Indian cotton cultivators ordinarily allow for this contingency by sowing a larger quantity of seed than would be required if all the seeds were sound, but better results can be obtained by sowing a smaller quantity of sound seed. A simple method of separating sound from unsound cotton seed has been found in the course of experiments to determine the proportion of seed injured by Red cotton Bug (Dysdercus Cingulatus Fabr.). Seed from plants infested with these bugs is often so injured that it does not germinate. The simplest test would be to throw the seed into water, when the bad seed might be expected to float, but the amount of fuzz on ginned seed varies so much that this test is not reliable. If, however, the seed is "pickled" with cowdung, earth and water, the fuzz does not affect the experiment. The process is to mix equal parts of fine sifted cowdung and earth with sufficient water to make a paste: this paste

is slowly poured over the seeds whilst a man rubs the seeds in the paste. The seeds are then gently seperated and dried for two or three hours in a shady place. When dry, they are thrown into water; the sound seeds sink, the unsound ones float on the surface and are removed. The following figures were obtained in testing seeds: the first column shows the number found bad by this test, the second shows the number found bad by the examination of each seed.

Jullunder ...	... 88	97
Sialkot ...	... 173	190
Umballa ...	... 171	176
Kasur ...	... 537	511

In every case 1,000 seeds were treated as above and a second thousand examined by splitting each seed with a knife. The general agreement of these figures shows that, allowing for the variations between the samples taken, the test is a reliable one. The procedure is simple and the advantage of sowing only sound seed is so great that the extra labour is a small matter.—(H. M-L.)

COTTON PESTS AND THEIR CURE. EXPERT ADVICE.

(Mr. H. Maxwell-Leffroy M.A., F. Z. S. F.E.S., Entomologist to the Government of India.)

The following are the commonly known species of cotton pest :—

(1) Aphis (small dark insects).

(2) The Red cotton Bug.

(3) The boll-worms (cater-pillar kind) by far the most important enemies to cotton.

(4) The stem borer.

(5) The stem weevil.

In cases of attacks by these pests, says the Government Entomologist expert, "the spraying machine and the best insectidites must be at hand.

Aphis can be checked with the sprayer without the smallest difficulty, and at a very small expenditure if taken in time. arseniate sprayed on the [illegible] as they form the first bolls much to check boll-worms; [illegible] pink boll-worm is abunda[illegible] lamp-trap is advisable.

Bhinda should not be grown anywhere on or near the farm, nor should garden Libiscus, Deccan hemp, or any other malvaceous plants.

Every individual red bug and stem borer should be rigidly destroyed; cotton, as picked, should be fumigated, the first plant seen to have stem-weevil should be burnt, and though no precautions can be taken against this pest, it may be possible to destroy a large proportion of the infested plants or prune off infested branches. Affected bolls and bored shoots should be burnt periodically, and

no cotton plant should be allowed to grow for a day after it has yielded its seed and is finished with. These are the principal precautions, which should be familiar to every farm overseer who has charge of cotton. A good deal of trouble and attention is required, and some expenditure, far more than is within the reach of the cultivator, but if cotton is grown as an experimental plant, if new varieties are to be introduced, and hybrids obtained, the expenditure is a mere trifle compared to the other expenditure, and to the ultimate value involved.

MON TIT-BITS CURE

icion should be aroused :he leaves of the plants go on twisting or folding ; on search insects will be found inside. In the first stage of the attack the insects may be collected together with the infected leaves, one by one, and then burnt in a heap outside the field.

Half a seer of Tirhoot tobacco leaves soaked in about half a maund of water for 5 or 6 hours mixed with a quarter seer of Kerosine oil and one *chittack* of Carbolic acid may be squirted over the plants with a syringe or a hay brush. That will cure the pest. A volume of smoke passed over the field 3 or 4 days in succession will also kill the insects.

SPRAYING OF PLANTS AND INSECT-CURE.

The "Journal of the Agricultural and Horticultural Society of India" for the latter half of 1905 contains an interesting contribution on the spraying of plants by Mr. R. E. Evans, inventor of a powder which, he claims, protects plants attacked by insect pests. The experiment was tried by the Society with great success. The plants treated were then examined and it was found that the fungus as well as the insects with which they had been attacked had been most effectively destroyed. The solution, it is added, is not to be applied in too great a quantity or it is liable to burn.

THE COTTON INDUSTRY AND ITS COGNATE BRANCHES. INSTRUCTIVE STATISTICS.

Agriculture has been the leading industry of this land since the dawn of history.

Next to agriculture in importance, comes the weaving industry —cotton, silk, and wool. Among all the materials of our textile fabrics, cotton unquestionably deserves the place of honour. It is believed to have also been manufactured in India before all other countries of the world.

Cotton is generally woven in India into piece-goods and calicoes,

Of these two, the manufacture of piece-goods appears to be the older one. Cotton-weaving appears to have reached its perfection in the hands of the Dacca manufacturers and those of Sonargaon, Dhamrye, Junglebari, Bajitpur and some other places close to Dacca.

To what great an extent this industry was once carried on may be gathered from an estimate made in 1753 by an English commercial resident of Dacca from which we learn that the aggregate value of the cloth trade of that city in that particular year alone was 28,50,000 Arcot Rupees or £356, 250.

Dr. Buchanon's researches held under the direction of the East India Company regarding some of the Districts of Upper Bengal reveal a similar flourshing state of things in respect of cotton spinning and weaving even down to the early part of the last century (1807) :—

I. Areas Under Cultivation.

Patna District	24000	Bighas.
Bhagalpur ,,	12000	,,
Dinajpur ,,	24000	,,

II. Females Engaged in Spinning Charkas.

District.	Number.	Value of thread spun.
		Rs.
Patna	3,30,400	10,81,000
Sahabad	1,59,500	12,50,000
Gorakhpur	1,75,600	not given
Dinajpur	not given	9,15,000
Purneah	,,	13,00,000

III. Hand-Looms in Working.

	Number
Patna ...	7950
Bhagalpur	7279 for cotton cloth 3275 for tassar.
Gorakhpur ...	6114
Maldah ...	4350
Dinajpur	500 families of weavers.

IV. Value of the Cloth Produced.

		Rs
Patna	...	7,50,000
Sahabad	...	16,00,000
Dinajpur	...	16,74,000
Maldah	..	[illegible]

Besides spinning, dyei[illegible] embroidery afforded a very [illegible]tive source of livelihood to [illegible]medan females in the [illegible] of Maldah. *Durri* makin[illegible] another very profitable occupation.

What a lamentable decadence this industry in all its branches has come to at the present day will at once appear even to a casual observer. Endeavours towards a restoration if only partial, of this once great industry of India will be so much energy and money well spent.

WOVEN FABRICS.

COTTON.

Indian calicoes are divided into :

(*a*) Plain calicoes (bleached and unbleached).

(*b*) Calicoes woven with coloured

thread (*Sushis* and *Keshis*, striped, checks, and tartans), and.

(*c*) Printed calicoes (on a white, or on a coloured ground).

The calicoes are principally manufactured in the Punjab and the Madras Presidency.

Cotton in various shapes is still finely woven at the following places in India :—

In the *Punjab* and the *N. W. Frontier Province*—Lahore ; Amritsar ; Peshawar ; Multan ; Ludhiana ; Umballa ; Hoshiarpore ; Jullundar ; Kangra ; Rahun ; Bajwara ; Syadwala ; Pakpattan ; ib : Kohat ; Hazara Hills ; Battalla ; Sialkot and in *Sindh*—Hala ; Tatta Karachi ; in *Rajputana*— and Jodhpur ; in the *United es of Agra and Oudh*— Jalaun ; Chandari ; Saharanpur and Benares ; in *Oudh*—Hardoi ; Tanda ; Nawabgange ; Baiswara Kheri ; Jais and Lucknow ; in *Bengal*—Santipore ; Chandernagore ; Pabna ; Dacca ; Sarail ; Patna and Jehanabad ; in *Central Provinces*—Bagri ; Bhandara ; Barhanpore ; Mohari ; Nagpur ; Pauni ; Chanda ; Hosangabad ; Khapa ; Maunda and Umrer ; in *Berar*—Akola ; Bolapore , and Elichpore ; in *Bombay*—Surat ; Broach ; Rawpur ; Dholeka ; Ahmedadad ; Kaira ; Yeola ; Ahmednagar ; Sholapur ; Gulutgud ; Bilhongal ; Parargad ; Nasik ; Dharawar ; and Poona ; in *Madras*—Urpada (near Coconada) Rajahmandry ; Nellore ; Yapalagunta ; Guntur ; Rapur ; Camti ; Molakalnura ; Shimoga ; Chittaldrug ; Harihar ; Kodlipet (Coorg) ; Bangalore, Madura, Vizagapatam and Masulipatam.

Dacca has never enjoyed and does not even now enjoy any monopoly of muslin manufacture, for in Sarail (in Tipperah, Bengal) a *tanjib* muslin was, and still is, woven, which is almost as fine as the muslin of Dacca, and the Nairs on the Malabar coast turn out equally fine muslins , and at Patna, Hyderadad, Cuddapah, and Arni some of the best plain muslins have for a long time been made and sold. Muslins are generally made plain (white), striped , chequered (*charkhana*), figured (*jamdani*), printed (with gold and silver), and embroidered (*chikan*, needle-worked). Benares, Delhi, Chandari, Nagpore, Gwalior, Nellore and Trichinopoly are a few other places where one or other kind of fine muslin is turned out every year in large quantities.

SILK.

Pure and fine silk fabrics have not been able to develop into perfection in this country ; but mixed silk and *tasar* and *muga* have had a most glorious place in Indian industrial history. As the Burmese and Assamese people generally put on silk cloths, this indus-

try has always afforded employment to a large number of people of this country. *Kincob*, or gold and silver-brocaded silk, is one of the most sumptuous fabrics of India. Like the Dacca muslin, the Benares, the Ahmedabad and the Murshidabad gold-cloths or *Kincobs* have been the admiration of the world since the earliest days of our commercial relation with foreign countries. It must be noted, however, that satin and velvet have never been made in India to any considerable extent.

Silk is woven to a certain degree of fineness at the following places in India :—

N. W. Frontier Province and the *Punjab*—Bhawalpur (Damasked silk) ; Amritsar (*Gulbadan* and *Daraji*) ; Multan ; Peshawar ; Nurpur ; Nabha and Patiala.

Cashmere—All throughout Cashmere.

Sindh—Tatah.

The *United Provinces of Agra* and *Oudh.*—Benares and Lucknow (*Kincob*) ; and Rai Bareli.

Bengal—Maldah : Bogra (*Garad*) ; Baharampur (*Kincob*) ; Rajshahye (*Matka*) and Bhagalpur (*Bafta*). Midnapur (*tassar, & garad*).

Assam—All throughout Assam *Erri* and *Muga.*

Central Provinces—Nagpur ; Chanda, and Narasingapura (*Tasar*).

Berars—Akola ; Ellichpur and Garcharali (*Tasar*).

Bombay—Ahmedabad (*Kincobs*) Surat (*Kincob* and *Gaji*) ; Thana (*Pitambara :* yellow) ; Poona ; Nasik ; Yeola ; Baghmandli and Guludgud.

Madras—Bangalore ; Hassam ; Toomkur ; Chittaldrug; Trichinopoly and Tanjore.

Wool.

We now come to woollen manufactures. Goat's, sheep's and camel's hair have been woven in India from very ancient times. The Cashmere shawl industry is of the highest antiquity and importance, and, as the late Mr. Caine told us, 'one of the most skilled crafts in th
Pusham and *Pushmina* a
eval with the shawl ma
The woollen stuffs know
and the blankets called
are also some of the mo
manfactures of India.

The following varieties of shawl are made in India :—

(1) *Shal-kitani-kar*, a shawl woven of twisted thread, giving it a peculiar, regular, serrated texture.

(2) *Shal-Sada*, a plain woollen shawl without embroidery.

(3) *Shal doridar*, a shawl having a *dori* or edging.

(4) *Do-shala*, a double shawl. Amritsar, near Lahore, has for several centuries been the great emporium of the shawl trade and all Cashmere goods.

But now the Paris, Lyons and the Paisley shawls are underselling

the Indian ones and the hereditary skill of the Cashmere weaver is going to be a lost art and specialty.

To this day however woollen fabrics of fine texture are manufactured at the following places in India :—

The Punjab & Cashmere—

Kangra (pattu), Nurpur, Sirsa, Rohtak, Ludhiana, (Rampore wool), Leia ('blankets) Simla, Delhi, Amritsar (Kerman wool), Lahore and Srinagger.

The United Provinces of Agra and Oudh—Lucknow (pashmina shawls).

Rajputana—Meriwar and Tod-

—Nuddea, Purneah and gpur (Kamblis)

—Ahmedabad (blankets)

—Chikanayakanahalli in (blankets), Kudlighir (*...mous*), Hasan, Kadur and Chitaldrug.

INDIAN NEEDLE-WORK OR EMBROIDERY

Inseparably connected with our silk and woollen manufactures is the great art of needle-work or embroidery. Indeed, it is difficult to conceive of a good shawl of Cashmere without its embroidery. Like weaving, it is also an ancient and traditionary industry of India. It is believed that its knowledge was first introduced into this country from the banks of the Euphrates. But whether embroidery is an indigenous art or not, Indian embroidery is one of the wonders of the human hand and has attained historical and universal fame.

Indian embroidery is generally wrought either in the loom or with the needle, and is done on silk, velvet, wool, cotton, and leather. Both the goldsmith and the silversmith lend their aid to most of these works. All the varieties of needle work found in Europe, feather-stitch, darn-stitch, cross-stitch, chain-stitch, drawn-stitch, net-work, cut-work, etc., are known to perfection by many Indian embroiderers.

The embroidery on silk, satin, and velvet reaches its high-water mark of excellence ... il beautiful works turned ... t Delhi, Amritsar, Lucknow, ... i, shedabad, Dacca, Surat, and Bombay.

The embroidered apparel of Vizagapatam and Chicacole in the Madras Presidency, of Hyderabad in Sindh, Nawanagar and Gondal in Kuthiawar have not only great commercial value but also represent some of the most remarkable fine arts of this country.

Muslin is now beautifully embroidered at Delhi, Patna and Dacca and leather at Phaka in Sindh and also in Guzerat.

GOLD AND SILVER THREAD AND LACE MAKING.

In connection with embroidery one cannot forget the rising industry of gold and silver wire, thread, and lace making of the present day. These are made at Delhi, Lahore. Lucknow, Murshidabad, Ahmedabad, Surat, Poona, Bombay, Dindigul, Bangalore, Vizagapatam and Chicacole. But Russian false gold wire is now over flooding the country and promises to nip this Industry in the bud.

At the census of 1891, so many as 12,611,267 people were found to follow the manufacture of textile fabrics as an occupation in India. At the last census, a slight diminution is noticed, the figure being 14, 214,158.

THE CARPET INDUSTRY OF INDIA.

This industry appears to be neither very old nor indigenous. Carpet manufacture seems to have been introduced into India by the Saracens who again learnt it from the Persians. Only the cotton *Sataranjis* of Bengal and the *Durries* of Northern India and the woollen carpets of Malabar and Coconada appear to be of pure Hindu design and of considerable antiquity.

The carpet industry of India which at one time gave occupation to several tens of thousands of people is now declining everywhere. But yet pile cotton carpets are made extensively and receive very good finish at Multan, Umballa, Mirzapur and seveal places in Bengal. Woollen carpets of some amount of fineness are still made at Agra, Jubbulpur, Mirzapore, Hydrabad, Warrangal, Masulipatam, Malabar, Coconada and several places in Cashmere and Sindh. Velvet carpets are made at Benares and Murshidabad and silk ones at Tanjore and Salem.

GRASS MATS.

Besides the above woven stuffs. many kinds of grass a[illegible] into mats. Those made a[illegible] (Malbar Coast), at M[illegible] Mymensingh Backergun[illegible] pore, Nuddea, and Purnea useful and durable stuf[illegible] also woven into mats at Sylhet in Assam.

COTTON MILLS.

New mills have lately been multiplying in Ahmedabad and the Punjab, and in other places. Not so in Bengal. And yet we have no cause for having doubts of the success of Cotton Mills, and hesitating to put our money in them. The cotton industry is in for a regular plethora of prosperity, and any one investing money in it is sure to get back his money's worth and more.

The Krishna Cotton Mills of Beawar have by this time become quite well-known in this part of the country by the various cloths they have sent out within the last few months. The Directors have just recommended a dividend of 19 per cent. for 1905 and taken over Rs. 1,10,000 to depreciation. Better than merely encouraging, we should think. We invite the attention of your monied classes to the successful operation of the Krishna Mill Company, which should encourage them to start Mills of their own.

:ar," says the "Indian ırnal," that the whole of tapled cotton produced l estates has been pur- ı syndicate of Ahmeda- vners. We further hear ements are being made to drive the Ahmedabad cotton mills by electric current, a well-known Bombay firm being interested in the enterprise. As this current will be produced with coal fuel in competition with the present coal heated boilers and engines, it is a proof of the hold that electric driving has got upon our very enterprising friends and rivals at Ahmedabad."

COTTON-GINNING FACTORIES.

In Gantur and its neighbourhood in the Madras Presidency which are great centres of the cotton industry, 10 or 12 ginning factories are reported to be at work in extracting seed from cotton.

Some of the factories are in Setanapalli, Mangalgiri, Bezwada and Nandigram.

Some might be started with advantage in the neighbourhood of cotton-growing tracts in Bengal and the business of oil extraction from the seed might also be taken up along with it. (vide, part III under head 'oil from cotton seed.')

BENGAL AND HER COTTON PRODUCING CAPACITY.

There is a vast area just now lying waste all over Bengal, which can be made to produce cotton, to great profit of the community at large. At present, Hill Chittagong, Hill Tippera, parts of Garo hills and adjoining tracts are the only important parts that grow cotton. But a time there was when even the level plains of Bengal, used to produce cotton of a superior kind. In the Sibpur Experimentrl Farm sometime back, Egyptian cotton plants were seen thriving vigorously on a low alluvial plot of land. By investigations and researches held in our country or in Egypt and America, some cotton seed variety or cross seed might be discovered that would suit the plain or alluvial tracts of Bengal. That would lead to increased cotton area in Bangal,

The Bhowal jungles and Madhupur jungly tracts of Dacca and Mymensingh grow some cotton though jute is a more favourite and coveted production. But still there are large tracts available which can be made cotton-bearing without interfering with the ready timber forest therein. There is an extensive forest tract in Assam in continuation of the Madhupur jungle of Mymensingh, which will grow fine cotton, but of which barely a tenth or one-sixteenth is under cotton or any sort of cultivation.

If we cast our eyes upon Northern Bengal, viz., the districts of Rangpur, Dinajpur, Bogra or the districts of Maldah and Purnea we shall find vast tracts of uncultivated high lands, which in climatic conditions and soil peculiarities resemble the cotton-bearing tracts of Mymensingh and Assam. Some parts of the Midnapur district and the greater part of Orissa and the Tributary States are more or less likely to grow cotton. The yield of cotton can be ten or twenty times increased by a systematic plan of work and by granting some specially advantageous terms to cultivators or future farms. At present no such stimulation is offered to cotton cultivation. A tenant or a company deserves special concessions in consideration of the capital and energy to be put in turning waste lands into arable fields or gardens. Our belief is that Hill Tippera, if properly developed, can be turned into a wealthy and populous cotton bearing state and its present yield increased twenty times or more (for terms of lease of land in Hill Tippera vide Part I. before.)

Our present yield of cotton does not represent even ten per cent of Bengal's possibility of cotton produce and the area can be increased many times its present limit, if systematic investigations are held and necessary measures for the purpose are taken in all parts of Bengal, Behar, Orissa and Assam.

BOOK ON COTTON CU[L]

Those interested in the [...] and prospects of cotton [...] will probably derive a go[od] useful hints from a work [...] with the same industry as conduct-ed in North Carolina. The author Mr. Holland Thomson, in *From the Cotton Field to the Cotton Mill*, gives a careful study of the industrial transition which has been brought about by the great expansion of the cotton industry during the last twenty years. The results of the consequent change on the life of the people are also fully discussed in their different aspects by the writer, who has been studying the problem for ten years. In other words, the work makes as strong an appeal to the sociologist as to the agriculturist, and in both res-

pects it is full of suggestions for the student of modern India.

All about Looms ; Spinning and Weaving.

HAND-LOOM VERSUS POWER-LOOM.

Some stubborn facts and figures and highly instructive comments.

Whether hand-looms could survive the competition of power-looms ?

The average hand-woven fabric gives nearly twice as much wear as the average mill-cloth by reason of the latter possessing less strength rability than the former p the following causes :—

The use of antiseptics in e used for conditioning cotton mills where the nd woven cloth must be protected from deterioration during long storage. ' 'Their use becomes necessary, particulary in damp climates and in countries which import cotton and export cloth, where a large stock of goods must be kept on hand. On the other hand, no antiseptics are used by hand weavers in their size, there being no need for it.

(*b*) 'Sectional sizing' as adopted in mills does not strengthen the much as 'single sizing' as COTTOong hand weavers.

FAC? power-loom, owing In Gantur anc motion being very hand in the Maa is not so firm as in the hand-loom where the weft threads and selvage ends are put in more carefully.'

We may remark that the use of antiseptics and germicides in Cotton Mills is well-known and dealt with in several English books on this subject, notably in Walmsley's 'Cotton Spinning and Weaving.' 'Sectional sizing' also being done in sections of yarn cannot be so perfect a process as 'single sizing' in which individual threads are treated separately.

Comparative consumption of foreign & home products.

Out of an approximate total of 442½ crores of yards of cloth consumed by the Indian people, imported cloth (chiefly from Lancashire) and Indian mill cloth together amounted to 278 crores of yards during last year ; whereas the cloth of the Indian hand-loom alone amounts to 164½ crores of yards approximately. These are figures worked out by Mr. R. B. Patel of Baroda on a very accurate basis.

Mr. Havell's opinion.

The following are some of Mr. E. B. Havell's remarks on this subject reproduced from his pamphlet on the 'Hand-Loom Weaving in India' published with a view to promote the objects of the Association for the Advancement of Scientific and Industrial Education of Indians,

"Though the hand-looms used in India to-day are the same as have been used for hundreds of generations, and hardly any attempt has ever been made to improve them, yet the Indian hand-loom industry has by no means been entirely crushed by all the marvellous skill which has been brought to bear upon the construction of the European power-loom. No doubt it is in a very depressed condition, but it is still, next to agriculture, the most important of Indian industries. Two-thirds of the skilled artisan population of India are, at the present day, hand loom weavers, and the value of the annual outturn of hand-woven fabrics is a matter of crores of rupees. We know that the very keen competition between European manufactures has reduced their profits to a comparatively small margin. If, then, the mechanical efficiency of the Indian hand-loom could be improved, say by 15 per cent, which would be equivalent to a 15 per cent duty on the imports of foreign piece-goods, it is reasonable to suppose that the Indian weaver might retrieve his position to a very large extent. Now it is not only probable but an indisputable fact that the ordinary Indian hand-loom can be easily made more effective, not merely by 15 per cent, but by nearly 100 per cent. There are many kinds of hand-looms in use in India, from a primitive arrangement of a few sticks to the elaborate and ingenious apparatus used for Benares kincobs and textiles of a similar class. *Hand-loom factories are profitable in Europe; they should be much more so in India, where conditions are so much more favourable. It is commonly believed in India that the hand-loom industry in Europe has been entirely supplanted by the power loom. This is very far from being the case.* In France, Switzerland and Italy there is still a great deal of silk weaving done by hand. In Scandinavia you will find the hand-loom in every and the peasant women only weave their own lin spin the thread they req sewing. In England, the centre of the power-loom i there has been lately a rem revival of hand-loom weaving. Hand-loom factories are being established in many places, where formerly everything was done by the power-loom.

If the hand-loom can compete with the power-loom in England, where the cost of skilled labour is many times greater than it is in India, where the supply of trained weavers is very limited, and where the most perfect weaving machinery, worked by steam and electricity, is in use, what a much greater prospect must there

be for it in India, where you have an unlimited supply of the most skillful hereditary weavers, content with earnings of three annas to eight annas a day !

I do not wish you to imagine that hand-weaving can hold its own against the power-loom to an unlimited extent. Both hand-labour and machinery have their limitations. But there are splendid possibilities open for the hand-loom industry in India, and it is a preventible loss to India that the skilled weavers should day by day leave their looms and add to the already overgrown agricultural population.

[illegible]h proper looms and proper [illegible]ion the Indian weaver could [illegible]y recover a good deal of the [illegible]ternal trade, but take a [illegible] position in the world in [illegible]woven fabrics.

Mr. Havells suggestions as to how to popularise improved hand-loom.

" You will be glad to hear that the Bengal Government, at my suggestion, are taking steps to make the use of the fly-shuttle known throughout the province. At present it is in partial use in 8 districts out of the 48. No doubt long and patient efforts will have to be made to persuade the mass of the weaving population to overcome their dislike to innovations, even though the benefits to be derived from them may be obvious. I would strongly recommend that the Indian Industrial Association should make this a prominent part of their programme. Your Association could easily form local Committees to assist and supplement Government efforts. If you succeed, as I am sure you would succeed, in bringing the fly-shuttle into general use among the weavers of Bengal, you would do a great service to your country. The mechanical improvement of hand-looms is, in my opinion, one of the most important industrial problems to be dealt with in India, and perhaps one of those which present the least difficulties. I only hope that other Governments will follow the lead of Bengal in this matter, and that District Boards and Municipalities all over the country will assist in reviving the great Indian hand-loom industry. It is my firm belief that there is hardly a more safe and lucrative field open for Native and European capitalists in India than there is in the development of hand-loom. I must say that if District Boards and Municipalities would take up questions of this kind, and *employ trained workmen to go round to the various industrial centres and give practical demonstrations of improved processes and apparatus, they might do much more than Schools of Art and Technical Institutes ever will be able to accomplish in spread-*

ing technical knowledge among the artisans of the country. I would commend this suggestion to the Committee of the Indian Industrial Association.

Babu Parvati Shankar Chaudhury, Secretary of the Association, said he wished to bear his humble testimony to the fact that during journeys he had made through the Pabna and Faridpur districts he had come across weavers who were using the new hand looms which had been partly introduced into these districts. These people assured him that before they were hardly able to earn three or four rupees per mensem, whereas now they were earning easily four or five rupees by the use of the new hand-loom. At Koostea he saw some thousands of fly-shuttles at work, the weavers using which were able to earn from nine to ten rupees, whereas formerly they were only able to earn five rupees. He was sure these new appliances would be appreciated by the general public of India, and would confer great benefits on them."

Mr. Henry H. Ghose (joint author with Mr. Dinabandhu Mukerjee of a good work on spinning and weaving) on the same: –

"In the face, then, of present-day competition and with his backward system of manufacture, how comes the hand-weaver to obtain such a large share of the textile trade of India? This may appear a puzzle to most of us, but I believe the reason is not far to seek. The disadvantages that the hand-weaver suffers from in his competition with Indian and English Mills are, after all, insignificant compared to two great advantages that he has over any power-mill, as stated below. To no other reason within the range of economic possibility could this result be attributed.

(1) *The greater durability of the hand fabric.* A good portion of the Indian people have found this from experience and hav[illegible] price for this cloth owi greater value it gives fc while others have either it to this test or are unab the cloth or have acquire ted taste for showy stuff. about this fact sometim have since found that Richard Marsden, perhaps the greatest living authority on weaving, has practically admitted it. This, you will realise, is the greatest truth in connection with hand-weaving and unless you recognise it, you can not understand the large consumption of the fabric nor the vitality of the industry.

(2) *Certain economies which the Indian hand weaver effects that the millowner does not.* The hand weaver being his own master and able to supervise any agricultural operation that he might have

expects no profit but merely a return for his labour of weaving. And often not being aware of the wages obtainable at the factories, he is satisfied with less than what he would get as a mill operative. Thus his charge for labour is low. Then he begins on a capital which is only about a tenth part of the outlay for and incident on a mill-loom. He pays no charges for management and supervision, being his own manager, foreman, tackler, store-keeper etc. He has besides no rates amd taxes to pay. It follows, therefore, that though ...r-cost of production is ...eater, he makes up for it by a saving of expendi... ...other directions. I have ... that it is this fact which ...terton unconsciously pro... he showed in his Report ...r equal conditions in the ..., the Wesleyan Industrial School of Karnal and the Chingle put Reformatory could not compete with the weavers of the locality. I therefore contend that even if the labour of the weaver operative in India were as efficient as it is in England, this improvement alone would not enable the mills to crush the hand-loom in ... country, as Mr. Johnson thinks.

During the recent revival, a good number of weavers have gone back to their occupation and the industry has also attracted many recruits ... iencing the old inconvenience in the preparation of warp. I consider it very necessary, therefore, that warp-preparing factories be established at different centres in the country ; also that the Sayajee Cottage Loom which has so far proved a success be given a fair trial by experienced weavers. Here also I wish to state that men of means and intelligence must enter the industry if we wish to thoroughly regenerate it, and it is nothing but proper that an industry which proves three times as great as the power-loom industry of India should gain such adherents. There is no doubt that small capitalists who would participate in it in the three following ways would find a better profit than in the general run of investments at the present day.

(1) The preparation and sale of warp at different weaving centres.

(2) The import of yarn direct from Bombay in these localities. (*vide* later, "Home-yarns for hand-looms.")

(3) The manufacturing of looms and weaver's implements. I know a few loom-makers in Calcutta who are earning a handsome profit by constructing merely the Indian Fly-Shuttle Loom. They are keeping nearly Rs. 20 clear on each machine.

Experiments on different methods of sizing and on the combination of motions in a loom are also very necessary. I am at

present engaged in such experiments with Dinobundo Mukerjee as it is quite evident that a stronger warp and a faster loom would improve our position considerably.

We would also advocate the institution of domestic weaving which we consider the proper thing for this country where slender confidence is bestowed on joint-stock enterprise.

A Stubborn Fact in Point.

That the hand loom can more than hold its own against the power loom receives practical illustration in the following fact noticed by the Indian Economist some time ago—

"In 1896 the manager of a mill in the Central Provinces wrote to the local Chamber of Commerce that within the previous five years 2 mills in Cawnpur had to discontinue the weaving of cloth and stop their looms because of their inability to compete with hand woven cloths. Here we have an apt illustration of the power of hand woven cloth to compete with that woven by machinery."

HAND-WEAVING IN INDIA.

IMPORTANT OFFICIAL REPORT.

MR. CHURCHILL'S LOOM.

Mr. A. Chatterton, officer in charge, Weaving Department, School of Arts, Madras, recently sent in to Government the following note on weaving, in which he stated the results of enquiries whilst in Bombay and Bengal during his recent tour. The influence of climate upon weaving has not been alluded to before in discussions of the Indian hand-weaving question; but it is, Mr. Chatterton thinks, a matter of very great importance especially in regard to the selection of localities for conducting practical researches with a view to the betterment of the industry :—

In May, 1901, an experimental Weaving Department was started at the School of Arts, Madras, with the object of improving the methods of hand-weaving in the South of India. It was that in the Basel Mission Establishments on the We the European hand-loom ployed with considerable for a great variety of fal of which, however, were pean style and mainly for I use. There seemed to be no reason why such looms or simple modifications of them should not be employed for weaving native cloths, and it was decided that the first experiment should be to set up a number of these looms and start manufacturing in them some material generally made in native hand-looms. As the result of a good many enquiries, Madras handkerchiefs, which are staple manufactures of the Presidency, were selected. There was a practi-

cally unlimited market for them at prices which, it was hoped, would pay. Similar work was also started in the weaving classes at the Chinglepput Reformatory and in the Wesleyan Mission Industrial School at Karnul. But at the end of about a year both these institutions found that the work was not profitable and gave it up thereby admittimg that even with the flyshuttle loom and methods of warping superior to those employed by native weavers they were unable to compete with them. The manufacture of these handkerchiefs has, however, continued up ... esent day in the Mad- ... Arts ; and although ... ever been carried on, at a ... t it has been considered ... loss is not greater than ... legitimately incurred in ... nts of this kind.

... months after the Weav- ... artment was opened in Madras, Mr. E. B. Havell, the Superintendent of the Calcutta School of Arts, drew attention to the weavers of Serampore on the Hooghly, where he had found them working with an old pattern of European hand-loom fitted with a fly-shuttle. The weavers, he said, were well off and able to turn out in their fly-shuttle looms twice as much work as did their neighbours with the common country loom. These statements were subsequently carefully verified for me by Mr. Radice who, at that time, was Collector of the Nadia District in Lower Bengal. From that time onwards Mr. Havell has been a persistent advocate of the fly-shuttle loom and in various ways he has succeeded in bringing it prominently to the notice of the educated classes in Bengal and has induced the district Boards and some of the Bengal landholders to take active steps to spread the use of the type of loom employed at Serampore in other districts.

2. The result of the experiments in Madras was not altogether satisfactory. It has been found that although it was easy enough to get the native weaver to work with the flyshuttle, the resulting increase in outturn was not anything like so great as our own anticipations and the reports from Bengal had led us to expect. It was found that though the rate of weaving could be more than doubled by the use of the fly shuttle, yet at the same time the threads of the warp were broken so frequently that the final result did not show an advantage sufficient to induce the average native weaver to take to the fly-shuttle loom. It was evident that if it was to come into extensive use, it would be necessary to materially improve the warps ; and a great deal of attention has since been paid to them, both in respect to sizing and to the

mechanical arrangement of the threads. Improvement in both these directions is possible; and In consultation with the English makers of warping and weaving machinery a set of preparatory machinery was designed which, it was thought, would place the preparation of the warps upon the most favourable footing possible. It is nearly three years since the indent for this machinery was submitted to Government, but for various reasons the purchase has been postponed, and it was only quite recently that Government sanctioned its transmission to the Secretary of State. As a natural consequence of this the weaving experiments in Madras for the last three years have not made much progress, but they have made the fly-shuttle loom very much better known than was formerly the case and have induced a certain number of people to take it up. From the records of the School of Arts, during the period under consideration, I find that 44 looms have been manufactured and sold to outside people and that as most of these have been used as patterns, it is probable that the number of fly-shuttle looms has materially increased in the South of India.

3. In other parts of India some attention has been paid to hand-weaving; but only in Ahmednagar and Bengal have results of a satisfactory nature been obtained. At Amritsar Mr. Shafi imported Japanese handlooms and started a small weaving factory, but apparently it has not met with much success as in the latest communication I have received from the Manager, he says "the greatest difficulty with us is the difficulty of sizing and unless we overcome it we cannot hope to make our loom of any good to the country."

At Ahmednagar in connection with the American Mission High School there has been established the Sir D. M. Petit's School of Industrial Arts, the manag of which has obtained America an expert mecha Mr. D. C. Churchill, wl the last two years has d himself solely to the improv of the hand-loom industry has attacked the problem in a more thorough manner than any one else and has obtained some very striking results which, I am inclined to think, will, if properly followed up, place the hand-loom industry of India on qnite another footing. He has designed a new hand-loom of a very simple construction, which, on a fairly large scale, he has demonstrated to be capable of dealing with a very inferior class of yarn and of being worked at a rate which I have never seen approached with any other type of hand-loom. Without

drawings it would be quite impracticable to give any intelligible description of the details of this loom ; and it must suffice to say that by swinging the slay the picking stick is set in motion through a series of levers and in such a manner that a very high speed of picking can be obtained. The slay can be easily worked with one hand and the shedding motion is controlled by levers. An important feature in Mr. Churchill's loom is that from the warping beam the warp passes over a roller mounted on spring bearings, whereby the action of beating up the weft has less ten- to injure a fragile warp. loom is also provided with itomatic take-up motion of genious character which can dily adjusted for either close en weaving. At the time of my visit to Ahmednagar a number of these looms were at work on dungari made from cotton of 10's counts both in warp and weft. The cloth was 36 inches wide and with an average of 28 picks to the inch the outturn was 30 yards in a day of 8½ hours. The following figures were given to me by Mr. Churchill as illustrating what could be done with these looms. Sold wholesale each piece of this dungari, 12 yards in length, fetched Rs. 2-0-6½ and the cost of manufacture was Rs. 1-12-3 a piece, made up as following :—

		Rs.	A.	P.
Cost of yarn	...	1	6	0
Weaving	...	0	3	6
Warping	...	0	2	0
Sizing	...	0	0	9

These figures show that a gross profit of As. 10-7 per loom per day is made and that too after paying the weaver As. 8 per day.

For the preparation of warps Mr. Churchill has designed what is really a wooden slasher sizing machine in which the steam drum for drying the sized cotton is dispensed with and in its place the warp is extended over rollers to a sufficient length to give time for it to dry. This undoubtedly works very well in a dry atmosphere, but it is doubtful if it would be successful in more humid districts. For winding yarns and reeling bobbins, Mr. Churchill has also censtructed machines built mainly of wood and capable of being turned out without difficulty in a carpenter shop or an industrial school workshop. In the preparatory processes of weaving Mr. Churchill has followed practically the same lines as we have done in Madras ; save that he has constructed the machines himself, whereas we have ordered them from England and he has adopted the slasher sizing process instead of hand sizing which we have considered more suitable.

4. I am of opinion that Mr.

Churchill has done extremely valuable work in connection with the hand-loom industry, and I think that it is extremely desirable that he should receive such pecuniary assistance from the Government of this country as will enable him to complete the work he has so successfully initiated. So far his looms have only been worked on coarse counts; but whilst in Ahmednagar I placed with him an order for a loom to be constructed for working with very much finer counts, and as soon as it is received here, I propose to employ it on the manufacture of women's cloths using 60 into 60's for warp and weft, and if it then proves to be successful, I shall try it on the finest work we are now doing, namely, angavastrams with 150's in the warp and 120's in the weft. Assuming that Mr. Churchill's loom proves ultimately to be what I anticipate he will be able to make it, it will, I think, greatly improve the prospects of hand weavers and should enable hand-loom factories to compete directly with those employing power-looms. In a hand loom factory, organised on a sufficiently extensive scale, the questions of warping and sizing will present no more difficulties than they have done in power loom factories. It is therefore desirable that Mr. Churchill's system of weaving should be tried on a fairly large scale and a sufficient number of looms employed to keep a complete warping and sizing plant in full swing and thus reduce the cost of the preparatory processes.

5. Government assistance should hardly be necessary where financial prospects are good, but there are few people who know anything at all of weaving and fewer still who understand the problems of the hand weaver. To make capital flow readily in the direction of the hand weaver it is necessary to demonstrate on a fairly large scale that the work can be carried on in a profitable manner. At the outset the difficulty to be overcome [illegible] organisation of a hand w[illegible] factory and the training of [illegible] ciently large number of [illegible] weavers, so that they ma[illegible] avail themselves of the poss[illegible] of the new hand-loom. All this work requiries considerable initial outlay and as there is no possibility of making a corner in hand-weaving, which might induce capitalists to invest considerable sums of money on the chance of ultimately getting a big return on their investments, it is not likely to be forthcoming and hence the necessity of Government intervention and assistance.

6. In the voluminous discussions which have taken place regarding the improvement of hand-weaving, it is a curious fact, which has

tacitly been assumed by every one, that the influence of the climate of the 'locality' in which weaving is carried on has always been considered of no importance, or rather the question of the influence of climate has never been raised. The success of the fly-shuttle looms in Bengal and the indifference with which it is regarded in Madras has for a long time, puzzled me ; because from all the enquiries which I have been able to make I could obtain no evidence of any superiority on the part of the Bengal weavers either in their mode of working or equipment. This I have been able to verify during my recent visit to When at Serampore and a, I saw the Bengal weavers with appliances distinctly to those in use in Madras. ied belonging to Purna ...anda Dey, the head weaver of Serampore, I found a number of looms at work. The weavers were paid monthly wages of from Rs. 10 to Rs. 12, and besides weaving they also prepare their own warps. The cloths on the looms were of 70's count both in warp and weft and with about 54 picks to the inch the outturn was 7½ yards per day of 8 hours. Warping with a machine of a primitive type was in use and the work turned out from it was obviously satisfactory as the weavers did not spend any large proportion of their time in mending broken threads in the warp. The process of sizing employed is exactly the same as that used in the School of Arts and the difference between what may be termed success in Bengal and failure in Madras is due neither to the degree of skill attained by the weavers nor to the prefection or otherwise of their apparatus. It is, I am convinced, entirely a matter of climate. In this I am borne out by numerous facts of which the following may be cited as evidence :—

(1) The average humidity of Lower Bengal is considerably greater than that of Madras, and there is no tendency in the former place for the warps to get dry and brittle except perhaps in the hot dry months before the rains begin when it is customary for the weavers to take their annual holidays, being the time of the year when they can least efficiently work.

(2) The West Coast of the Madras Presidency possesses a climate which, as regards humidity, is comparable with Bengal. There the hand-loom factory of the Basel Mission has met with a degree of success which has not been attained anywhere else, and at the bottom of that success lies the fact that the work has been carried on in a suitable climate.

(3) From the records of the work done by weavers in the School

of Arts, Madras I find that in April. May and June, when the average humidity was 64 per cent, the outturn of work was $2\frac{1}{2}$ yards per loom per day; whilst in October, December and January, when the average humidity was 75 per cent, the outturn of work with the same men was $3\frac{1}{2}$ yards per day.

(4) It is a well-known fact that native hand-looms are generally fixed in damp excavations in the ground, so that the weaver may work in a moist atmosphere. Further the weavers though they work extremely long hours generally rest in the middle of the day and work by lamp-light far into the night. It is hardly likely that they would do this unless the colder hours of the night were more favourable for carrying on their work than the dry time in the middle part of the day.

5. This is sufficient evidence to show that weaving can be best carried on in a damp climate and that climate has had considerable influence over the success which the fly-shuttle loom has met with in different parts of India. In England the cotton trade is mainly concentrated in Lancashire which possesses a moist climate combined with great facilities for the production of power. Native weaving has always been an industry scattered all over India and weaving has been successfully carried on in extremely dry and extremely moist regions; but there is no question whatever that the finest and best work has always been the product of damp districts. It must be remembered that the native hand-loom imposes much less strain on the warp than does any form of fly-shuttle loom. Better warps are therefore required in fly-shuttle weaving to obtain the maximum advantage from this system. It is only just now that we are begining to recognise this, and attempts are being made to provide stronger and more evenly arranged warps. In Bengal excellent work has been d[illegible] on the old native system [illegible] ing, but in the drier climat[illegible] prevails over the greate[illegible] India, the native warp [illegible] proved satisfactory when [illegible] to the stresses which are i[illegible] set up in the fly-shuttle looms. By passing a warp over a roller mounted on springs, Mr. Churchill has undoubtedly reduced the number of breakages and the slasher system of sizing must be good enough for any form of hand-loom, seeing that it is perfectly satisfactory when used in power-loom factories where the strain on the warp is very much greater. Accepting then as we must, the fact that some climates are much more suitable for weaving than others, it becomes a matter of vital importance in any attempt to

improve the position of the 'hand-loom weaver that it should be undertaken under conditions as favourable to success as possible. For this reason therefore unquestionably the West Coast of India or Bengal should be selected for establishment of the first hand-weaving factories. As a matter of fact, they already exist on the West Coast, and it is almost certain that establishments similar to those of the Basel Mission would be equally successful if they devoted themselves to the manufacture of native goods. I think it is highly probable that even for coarse work the hand-loom would be able to own if only to the ment of hand-loom weaving the same energy and were available as are invariably considered necessary for the of a power weaving shed.

8. The native weaving trade is a huge, unorganised, helpless industry. The weavers are ignorant, uneducated and utterly unable to grasp the economic situation with which they have been brought face to face. Practically each loom, or at the very outside each weaving family, is the unit of the trade and the progress of the past has depended upon the unassisted efforts of such units. It can hardly be doubted that the introduction of the factory system among the hand-weavers will effect an important revolution and will postpone, possibly, indefinitely their extinction by the power-loom. Since I have seen a hand-loom working satisfactorily at 160 picks a minute and imposing no undue amount of fatigue upon the worker, I am certain that this machine, which can be turned out in large numbers for not more than Rs. 60, must, if it is properly pushed, prove a very potent rival to the power-looms over which in the past the utmost resources of human ingenuity have been devoted to their perfection. It is but a little more than four years since we began the first attempts to systematically study the hand-weaving problem in India and the success which has been met with so far, more than justifies the efforts made and the expenditure incurred, and I am strongly of opinion that the Government of India may now, and with the utmost possible advantage, deal with the question since the work is one in which climate influences play so important a part. My recent enquiries in Bombay and Bengal as well as the knowledge I have of what is going on in Madras clearly indicate that in each province work is being carried on on the right lines and that now it is desirable to fully recognise this, and to use the utmost efforts possible to procure a rapid development along the lines which have already been clearly marked out.

A GOVERNMENT GRANT.

The proposal to establish a hand-loom factory in which Mr. Churchill's newly designed hand-looms, sizing machine, and other apparatus may be given a thorough trial has the cordial approval of Government, who are prepared to allot immediately Rs. 15,000 or Rs. 20,000 for this purpose.

With regard to the locality at which the factory should be established the Government consider that the West Coast would be too far off to allow of convenient supervision, and are of opinion that Salem or Madura, would be more suitable.

A FEW TIMELY HINTS.

(From Mr. Kailash Chandra Bannerjee of Arrah.)

The weavers, as we see in this part of the country, have first to borrow capital at a high rate of interest to purchase thread to weave cloths. Then they have to prepare the cloths themselves with their manual labour; and thirdly to take them to the market for sale. If they be relieved of the first and the third, they would have ample scope to work heart within and God overhead in their own particular line. It is this mixing up of the functions so diametrically opposed to each other in the same individual that brings about the disruption of the whole fabric. So if the capitalists could devise some means of starting a concern where thread can be had for value, or in advance, or on credit by the weavers this would no doubt afford great relief to the weaving class. Then when the cloths are made ready, they can be purchased at once by such concern at a certain fair rate agreed upon between the parties; and, lastly, these cloths may be sold in the market by the same concern. The concern may be established in a convenient centre for the purpose of promoting the three objects I have mentioned above. Th[e thread] may be purchased from [the Em]press Mill or some oth[er mill] taking care that for *tani* purposes, strong threads a[re used] and for *bhurn* (waft) purpo[ses] good threads are supplied.

Suppose, one of our capitalists starts such a concern at Chandernagore, Serampore, Santipore, and provides all the weavers with thread, say nos 20*s*. or 16*s*, or some higher counts still prepared in India, to be woven into cloths which are to be made over or returned to the concern, keeping their own profit, would not the business spread like wildfire? For such a purpose, you have only to select the agents who will have to work in such fields. The mill owners may be at once communicated with and the purchasers of

customers are ready to make the purchase, giving a fair profit to all the parties concerned. Let there be no intermediaries in great numbers.

It is not very difficult to act upon the above principle. Here you have not to look for fly-shuttle looms of Japan or Serampore or any other kind. Let the indigenous looms be worked in their own way by placing both legs in the earth-hole and worked up and down, and the shuttle worked by both hands. The weavers have acquired a facility in working in this way, and it cannot be ...ected that you can get ...ew hands to work on the ...e within a short time with ...ility. So let the indigen... ...vers go on in their old way ... new stimulus and facili... ...ch we can provide them with. In the meanwhile, let us learn to work the fly shuttle successfully.

Yesterday two gentlemen came to me to learn the art of weaving, by the fly-shuttle loom process. They belonged to the highest class, and still they were not ashamed to learn the art. This is, indeed very praiseworthy, for we do not see any reason why such a noble art should be the exclusive trade of any particular class of people? I advised them, first, to learn the art in the indigenous way, next by the fly-shuttle loom, and, last of all, by the so called power-loom, and that we may be able to use the *bullock power*, or other animal power as substitute for the steam-power in course of time.

Those engaged in other trades and callings may be turned back, and the rank and file of actual weavers swelled to make the movement a success. Hands we have yet enough of now diverted to other kinds of trades and callings and it should be our aim to bring them again into the fold and make them work on their old lines which they had long given up owing to our indifference and inattention.

THE SERAMPORE WEAVING INDUSTRY.

REMARKABLE DEVELOPMENTS.

A century or so ago the little riverside town of Serampore figured largely in the history of Bengal. With the rise of Calcutta, however, and the transfer thereto of the once famous press where the "Friend of India" was published, Serampore, receded from the position it occupied and became a place of but little importance. But once more the tide of prosperity appears to be on the flood and there is some promise

that the town will before long be the seat of a large and thriving industry.

Serampore for some time past has been regarded as the home, in Bengal, of the handloom weaving industry. A large number of weavers live in its vicinity and the cloth made by them has enjoyed a certain reputation. Mr. E. B. Havell, of the Calcutta School of Art, was some time ago attracted by the possibilities of the Serampore fly-shuttle loom, so much, indeed, that he conducted a somewhat extended and personal investigation as to its daily outturn of cloth and the main features of its working. Mr. Havell was so far satisfied with its excellence that he recommended its use, and also assisted in the formation of a training institution for weavers. Shortly afterwards with the largely increased demand for country-made cloth, principally dhoties, Serampore became the centre of a rapidly developing industry. News of this development spread throughout the province and large numbers of Bengalis interested in the matter visited Serampore to see the looms at work and to obtain information of the conditions which controlled the industry. The introduction into other districts of Bengal of the Serampore loom was eagerly sought, but a difficulty regarding labour was raised. The "weaving masters" available were limited in number and were moreover, required for local needs. Mr. Havell's experimental school was in the meantime, working very satisfactorily and when the demand for weavers was mad, three other schools were quickly founded and in these four schools forty students were presently engaged in mastering the rudiments of the weaving craft. Two lots of passed students have already been sent out. They hailed from Chittagong, Tangail, Rungpur, Mymensingh, etc. None of them belong to the weaver class, but are men of respectable parentage, some of them inde... Brahmans, and nearly all ... of English colleges or ... High Schools. This fa... itself, worthy of more tha... note, for it is well-know... to this time the better-cla... Bengali people have c... weaving or any other form of manual labour to be unworthy of their attention.

The schools have now their full complement of students and the principal of one institution stated to a "Statesman" representative that he had more applications then he could hope to deal with for some time to come.

The Serampore fly-shuttle loom is worked by one weaver only, and in a day of eight or nine hours can turn out a pair of dhuties. There are at the present time 150 looms at work in Serampore, and

they are capable of producing sufficient dhoties to meet the demands not only of Serampore town but also of the villages in the sub-division, leaving a considerable quantity for disposal to other places outside its borders. As a matter of fact, so far as the actual outturn of cloth is concerned there can be little question that each district, if its inhabitants choose to take up the matter, can supply its own demand. There is, however, a difficulty to be encountered and it is the difficulty of cost. The coarse turned out in Serampore purchased at Rs. 2-8 per ce that does not compete y with that of Euroods of similar quality. It ssible to reduce this rate of the cost of labour and aterial. It is nevertheless pointed out with some confidence by those engaged in the trade that the high rates of labour now paid and the price of thread are but temporary. As more weavers are trained, competition will reduce wages and the next few months will also see a reduction in the prices at present paid for the material. The demand has been sudden and the consumers' resources so far as raw material is concerned have been limited to one market. They are however arranging to better this latter condition and will then be in a position to enter into serious competition with the foreign market.

The cloth manufactured at present is of a coarse texture and for this there are several reasons. In the first place the ordinary Serampore loom does not give satisfactory results with the finer threads, that is to say beyond 120 counts. The weavers say the loom subjects the finer material to too heavy a strain. But there is a hand-loom at work in certain of the villages adjacent to Serampore (Atpur, Kaikala, Joynagore and Khursarai), whereon the higher counts can be worked and which turns out cloth of an extremely fine texture. This loom, in its main features, is similar to the Serampore fly-shuttle loom. A second reason is the very much heavier demand that exists for the coarser cloth. Some of the weavers, however, say that in Lower Bengal the damp atmosphere had a certain effect on finer threads, but this belief on inquiry, was not found to be widely held. In addition to the above a Japanese loom was seen, but this had not been worked. It is capable of a far greater outturn than either of the Serampore looms and is worked by a treadle at a great speed. Its cost delivered at Serampore works out at about Rs. 185. An English-made loom was also seen at work. This machine which, when compared with the indigenous article, is of

a complicated character, was being used to produce cloth somewhat similar to the well-known cotton tweed, but of coarser texture. It worked rapidly although the owner stated that only about twelve yards of cloth could be turned out per day. He was not of opinion that this machine would attain to any popularity. It cost Rs. 300, was very complicated and when out of order required mechanical knowledge for its repair. Moreover, the cloth manufactured only sold at four to five annas a yard and this provided no adequate return for the great difference in price. Taken altogether the weight of local opinion is decidedly in favour of the Serampore fly-shuttle loom. It is cheaply made, easily worked, and when out of order can be repaired by anyone who has worked it half a dozen times. Moreover these looms occupy but little space and are portable.

LOOM MAKING.

Side by side with the advance of the weaving industry itself has grown the greatly incresed demand for looms. Formerly these looms were made by local carpenters, the demand not being sufficient to enable the makers to devote their whole time to this branch of their business. All this is, however changed. Eight factories, each turning out an average of twenty-five looms per month, are now in full work. Orders are being received from almost all parts of the province and loom-making seems to be attaining nearly as important a place in the Serampore industrial world as weaving itself. At one of the training schools the principal stated that when each of his students left for his district he took with him a loom, and in some cases several looms. The demand was growing, and those interested in the industry were enthusiastic when speaking [illegible] possibilities. From what [illegible] seen, and our representati[illegible] a fairly extensive tour [illegible] schools and loom-maker[illegible] there cannot be much d[illegible] garding the soundness of [illegible] development of the S[illegible] movement; and perhaps, the soundest feature of the present situation is the eagerness with which young men are throwing up their advanced studies and, in some instances, situations already secured, to devote themselves to weaving. It is fairly certain, too, that as labour and material become cheaper and when the further improvements already freely spoken of in the hand-loom are introduced, greater strides towards the substitution of country-made cloth for that of foreign manufacture will be made.—"*Statesman.*"

HOME YARNS FOR HAND-LOOMS.

A well-known and influential banker and mill-owner in Baroda, Seth C. M. Samel Becher thus writes to the Amrita Bazar Patrika :—I hear that at present many hand-looms have begun to work in Bengal, but unfortunately they have to import their yarn from Europe. If this be true this is not pure Swadeshism and therefore; if your people have a mind to import native yarn, I shall try to turn out such yarn in my mill which almost complete and will work in about 4 or 5 If so please let me know t of yarn i. e. of what your people will require ıer they also import dyed ised yarn. I think this information will be well obtained if you refer to some yarn merchants who generally import from Europe and also ascertain the wishes of your people."

MIRACULOUS LOOM AN AUSTRIAN INVENTION.

If Edison be the wizard of the New World, then certainly Jan Szczepanik holds a similar position in Europe. Although still but thirty-two years of age, his name is already immortal as the inventor of a loom which does in a few hours what by old methods took years. He presented to the Emperor of Austria a piece of tapestry containing 200,000,000, crossings of silk thread, which was begun and finished within five hours. By old methods this would have taken four years to make. The Secretary to the Bengal Technical Institute should at once make enquiries about this loom. The inventor, we believe, belongs to Vienna.

THE FLY-SHUTTLE LOOM.

Its peculiarity lies in the fact that the shuttle is thrown by means of lever-contrivance instead of by the hand.

Both hand and feet are used. The right hand is used in giving a pull at the lever which works the shuttle and the left in drawing the reed to press evenly the weft thread, and the feet are pressed on the pedals for raising and lowering the healds having the warp threads.

One pair of cloth of 40 or 50 counts twist can be woven on this loom in nine or ten hours. A pair of cloth of finer twist, say 90 or 100 counts, will take twelve or thirteen hours to weave. Three and a half hanks or more of twist would be sufficient for dhoti, 10 yards by 44 inches.

A complete loom will consist of the following parts—One strong wooden frame ; one *dakti* of lay

on which the shuttle or *maku* runs: one *sana* or reed; one shuttle; one beam or roller for winding the warp, one beam or roller for the woven cloth, one pair of healds for raising and lowering the warp threads, two wedge-shaped frames for making the healds, six wooden see-saws or *natchees* for fixing or hanging the healds, one pair of paddles or flat pieces of wood with cords for raising and lowering the healds; one dozen pirns or shuttle-bobbins.

The processes of sizing the yarn, and winding from hank to bobbins, and making the warp, and winding the weft yarn on to the pirns or shuttle bobbins are the same as are followed by all our country weavers for their ordinary hand-looms. And the accessory apparatus for these operations consists of two bamboo *charkis*, one *natai*, one spindle, one bobbin frame, 200 bobbins and 50 pirns and will cost from Rs. 5 to Rs. 10 according to the material used and can be secured cheaply from any village weaver or carpenter.

I.—Advantages of the Fly-shuttle.—The fly-shuttle has three advantages: *first*, it enables the weaver to weave much faster than he can when he throws the shuttle by hand. A common fly-shuttle loom can turn out nearly twice as much work as the ordinary native loom in the same time and of equal quality. The latest English looms work four or five times as fast. *Secondly*, a weaver by means of the fly-shuttle can weave cloth of much greater width than he can in the native loom. In the Pabna and Faridpur districts the weavers, since the fly-shuttle loom has been introduced there, have been able to double their earnings by making a kind of bed sheet which finds a ready sale among the natives. *Thirdly*, it is an extremely simple and inexpensive improvement, which can be made by any carpenter and adapted to the ordinary native loom. It can be used in both silk and c[illegible] weaving. At Serampore it is [illegible] for silk and also for cotton, counts 86s. up to 120s. For coarse counts of cotton it is [illegible]sable to modify the Seran[illegible] loom so as to adapt it for a [illegible] shuttle. It can easily be ad[illegible] to the weaving of gunny.

II.—Cost.—The whole loom used at Serampore is almost the same as is used in Europe, only it is more roughly made, and costs from Rs. 25 to Rs. 35 to make. It is easier to weave good cloth on this loom, but it is not necessary to have this kind of loom in order to use the fly-shuttle. The part of the loom which contains the fly-shuttle can be adapted to the native loom at a cost of about Rs. 8 or Rs. 10. The Serampore loom has been adopted by many

thousands of native weavers in Bengal, who have doubled their earnings by the use of it.

III.—Description of the Fly-shuttle and method of working it.— There is the part of the loom containing the fly-shuttle, which is called the "lay," as used at Serampore, and the fly-shuttle itself. It is generally about 14 inches long and the ends of it are of iron, and it has two iron wheels fixed underneath. The shuttle is placed in one of the shuttle-boxes on the right or left end of the lay. To work the fly shuttle, the shuttle is d in the right-hand box. the weaver, pressing down readle, so as to open the ls of the warp, pulls the e, quickly towards the left. huttle is thus jerked through rarp into the left shuttle- The weaver then presses down the other treadle to cross the threads of the warp and pulling the handle towards the right, sends the shuttle back into the right shuttle-box. By repeating this simple operation the whole weaving is done.

IV.—Time required to become expert with the fly-shuttle.—A skilled weaver can become fairly expert in the use of the fly-shuttle in less than a month. The chief thing to learn is to pull the string evenly and with the right amount of force. If it is jerked too violently or not smoothly, the thread in the shuttle is broken and much delay is caused.

V.—Importance of teaching the use of the Fly-shuttle.—According to the census of 1891, there are about 380,000 weavers (males) in Bengal alone. If the earnings of each weaver could be increased only by Rs. 2 a month, which is a low estimate of what might be obtained by the use of the fly-shuttle, it would be a gain to the Provinces of Rs. 9,120,000 a year. These figures are sufficient to show the importance to Bengal and to the whole of India of this invention which has been used in Europe for 150 years.

Note. When a number of threads of different colors are used in weaving a cloth, the frequent changes of shuttle required make the use of the drop-box advisable. This is a revolving box fitted to the end of the lay by means of which each shuttle is dropped into its place as required. The fly-shuttle cannot be used when the weft threads do not pass right through the whole width of the cloth, as is the case in cotton cloths with borders entirely of silk or gold lace, but it can be used in any loom or in any material in which the shuttle passes right through weft in one operation.

To the Editor of the *Pioneer*

Sir,—Since I last wrote to you on the revival of hand-loom weaving in India, there has been very great progress in the movement. In fact it may be said that hand-loom weaving has now been placed on a sound commercial basis, with al

most infinite prospects of expansion. I have lately returned from a visit to Amritsar, where a young Mahomedan, Mr. S. M. Shafi, after a course of instruction in the Technological College of Tokio, has set up a hand-loom factory, which has now been working for about six months. He brought from Japan an excellent model of a foot-loom, worked by a treadle, and a warping mill and creel of the improved European pattern. He employs the local mistris to copy the loom, six of which are now worked by local weavers. The latter become experts in a few weeks and turn out at least three times as much cloth in a day of eight hours as a whole family can do on the ordinary native loom in ten or twelve hours. The conditions of work are so satisfactory that each weaver is content with four annas a day, which are about the earnings of a whole family with the old native loom. Their women-folk and children are now free to do other work, or to attend entirely to domestic concerns. For the proprietor of the factory the results are eminently satisfactory, as he makes a profit of about eight annas per day on each loom, and when the number of looms is increased the working expenses will be proportionately reduced. It is obvious that there is here a margin of profit sufficiently large for reducing the price of cloth to a level at which the power-loom factories could not compete, stlll retaining a splendid return on the capital invested. At present this factory turns out coarse shirtings about $\frac{13}{18}$th of yard wide, with thread of count 30s. Each loom is calculated to produce 25 yards of cloth per day of eight hours. The higher counts could easlly be used by similar looms if more care were taken in the constrUctlon. The looms could also be used for silk or wool.

Mr. Shafi was at first incllned to refuse to assist others in joini[ng] this highly profitable ind[ustry] but wiser counsels have pre[vailed] and he has authorised me to [say] that he is willing to sell m[odels] of his loom at reasonable [prices] and to give instructions in th[e use] of them. Mr. Mahbab [A...] Editor of the *Paisa Akhbar* [of La]hore, also proposes to open [a te]chnical school for teaching the use of these looms. I hope his example will be followed by many others. The same model of loom has also been imported by Mr. K. M. Dey, of 45, Radha Bazar, Calcutta, who will be glad to show it to anyone. The next important step gained is that Messrs. Hattersley and Sons, the patentees of the "Domestic" loom, which has been such a great success in Roumania, in Egypt, and in the Andaman convict establishment, have, at my request, consented to put in

hand a new model of loom specially adapted for India, and of sufficient width for making *saris* and *dhotis*. This model will have a special arrangement to reduce the labour of the teadling, which has been found unsuitable for Indian weavers. I hope to be able to demonstrate the working of this model in Calcutta shortly. As I have been overwhelmed by inquiries regarding these looms, I should be glad if you will allow me to state that Messrs. Shaw, Wallace and Co. of Calcutta are the s in India of Messrs. Raffael Manchester, and Mr. Thos. :lough, London, have also ıed me that they have in models of improved hand- specially adapted for Indian tions. I am endeavouring to ge for an exhibition of im- d weaving apparatus which will be of immense advantage to all who are interested in the industrial progress of India. I am indebted to Major A. R. S Anderson, I. M. S., Medical Officer at Port Blair, for the following particulars of the working of Hattersley's looms in the penal settlement. The model used is that known as No 96. The ordinary task is 30 yards of cloth, 28 inches wide, No. 8 count 22 picks per inch. Women have, however, turned out 50 yards in the working day of eight hours. After a little preliminary difficulty there has been no trouble in working the looms. Some of the women take a very intelligent interest in the working of them. As there are large machine shops in the settlement there is no difficulty in repairing breakages. To repair the looms a skilled mechanic is required, if the pieces are made locally, but duplicate parts can always be obtained from the manufacturers or the agents. There is no skilled mechanic specially employed to look after the looms.

I think it is almost impossible to exaggerate the importance of the facts I have stated above. We have now successfully working in India:—1st the Serampore loom which has helped many thousands of weavers in Bengal to double their earnings. The essential part of it can be adapted to the ordinary native loom for about ten rupees, and on account of its simplicity and cheapness it is not likely to be superseded. 2nd. The Amritsar loom, a combination of wood and iron, simple enough to be made by ordinary mistris, which will treble the earnings of the ordinary weaver and is not so expensive as to be entirely beyond his reach if reasonable facilities are afforded him. We shall also have shortly several models of the very best type of the modern European hand-loom which is now competing successfully with the power-loom even in Europe. There is

no reason why they should not become as popular in India as sewing machines and improved sugar mills which can be obtained in almost every large village through hiring agencies. The example of Mr. Shafi might be followed by thousands of successful as well as failed University candidates, with small capital, who are now hopelessly seeking for an easy, clean, and decent livelihood. I have always contended that the greater part of the textiles which are imported into India to the value of £20,000,000 sterling annually could be made profitably on Indian hand-looms. The way to reach this most desirable consummation seems now to be clear.

SCHOOL OF ART, *Calcutta, Nov, 1904.* } E. B. HAVELL.

PREPARATORY PROCESSES OF WEAVING.

The economies which can be made in the old-fashioned processes for preparing the warp for the loom are even greater than those which can be made in the actual weaving. By the ordinary native method the thread for the warp is wound from two spindles held in the hand while the workmen walks up and down passing them between two rows of sticks. At Serampore all the exertion of walking the distance required, which must amount to many miles a day, is obviated by a simple framework with rows of reels, from which the thread is arranged as required on pegs stuck in the wall of the house. By this method 50 or more threads at a time can be arranged and the whole apparatus costs not more than two or three rupees. The apparatus is supplied by Mr. P. N. De of Chinsurah, Bengal, and by Purna Chandra Dey, Head-weaver of Serampore. This method, on account of its cheapness and simplicity, is admirably adapted for village weavers' use. The importance of [illegible] economies in the prelimina[illegible] cesses of weaving will be [illegible] when it is understood that [illegible] half the cost of weaving a c[illegible] incurred in the work of pr[illegible] the thread for the loom.

At Serampore the ordina[illegible] dian hand-sizing process is [illegible] Mr. Kelkar of Indore has h[illegible] invented a hand machine f[illegible] proving and cheapening this process.

LOOMS SUITABLE FOR VILLAGE WEAVERS' USE.

The Serampore model of loom on account of its cheapness and simplicity is the most suitable for introduction among the poorest class of plain weavers both in cotton, silk and wool. By adapting the "lây" to an ordinary village loom and by using the improved apparatus for winding the thread

of the warp, the outturn of looms can be doubled at an initial cost of from Rs. 12 to Rs. 15 each. It should be remembered however, that the finer the thread used the more accurate the workman-ship of the lay must be. Seasoned wood must always be used, otherwise the lay will become warped and not work accurately.

At Bijapur, the Serampore loom has been used successfully with hand-spun thread. In Bengal, machine-spun thread is always used.

'. N. De of Chinsurah, Ben-
. Babu Purna Chandra Dey,
eaver of Serampore supply
'ampore loom or the lay.
›anese model of loom, in-
1 by Mr. S. M. Shafi in
ving factory at Amritsar,
'ith a foot treadle instead
e hand and is faster than
ımpore loom, but it is more
...ve. It is made of wood and iron and would probably cost under Rs. 50 in labour and material. Mr. Shafi supplies models of the loom. Messrs. Jessop & Co. Ld., 93 Clive Street, Calcutta are about to start manufacturing them in a large scale with the idea of selling them as cheaply as possible. The loom is imported direct from Japan by Messrs. Khetter Mohun Dey of 45, Radha Bazar and Messrs. Stewart Mackenzie & Co. of 1 Garstins Place, Calcutta.

An improved loom working up to 150 picks a minute with No. 10 counts of thread has also been introduced into the Sir D. M. Petit School of Industrial Arts at Ahmednagar. The Government of Bombay propose to endeavour to bring it into general use in that Presidency.

Looms etc. suitable for Hand Factories or Weavers with small capital.

For small capitalists the cheapest loom is the Japanese model used by Mr. Shafi at Amritsar, made of wood and iron. This is an automatic hand-loom (Flowers' Patent) manufactured by Messrs. Robert Hall & Sons, Bury, near Manchester, England, and used in Ireland, for cottage industries. It is worked entirely by the hand without any assistance from the foot. The same manufacturers also supply a very wide fly-shuttle loom making sheets up to 120 inches in width and a hand beaming mechanic for preparing the threads for the warp, besides a number of other hand appliances. A hand machine somewhat similar to this is used by Mr. Shafi for preparing warps for his hand-looms. Messrs. Hattersley's domestic looms are more expensive, (ranging in price from Rs. 150 for 30″ looms to about Rs. 220 for 50″ looms, Calcutta delivery) but they are a first class machines used with

great success in Roumania and other places in Europe, and also in hand factories in Cairo, and at the penal settlement in the Andaman Islands. They are adapted to weave either silk, cotton, linen or woollen cloths and the extraordinary speed of 180 picks per minute has been attained. The "domestic" looms are made in widths from 28 inches reed space up to 50 inches. Messrs. Hattersley have recently produced a model of loom 50 inches reed space specially adopted for weaving *saris* and *dhotis*.

The same manufacturers also supply the apparatus for the preliminary processes of preparing the warp and other appliances.

Messrs. Hattersley's agents in England are Messrs. Baerlein and Co., Manchester, and in India Messrs. Shaw Wallace and Co., Strand Road, Calcutta. Messrs. Raffael Bros., of John Dalton Street Manchester, England, are also the makers of first-class looms, suitable for hand-factories and for domestic industry in India. They have recently designed, a special model specially adapted for Indian requirements. Their looms have the advantage of being simple and strong in construction, and thus not liable to breakages.

INSTRUCTION IN HAND-WEAVING

Mr. P. N. De gives instruction in the use of the Serampore loom and warping apparatus in his establishment at Chinsurah, Bengal. He will also send weavers competent to give instruction to any part of India and arrange to give demonstrations at melas and exhibitions. Mr. S. M. Shafi gives instruction in the use of the japanese foot-loom at his weaving Factory at Amritsar The Government of Mysore have opened several small weaving schools and give assistance to some others established by privat terprise. One at Hole Nar has been particularly succ The Government of Trava have also established one at vandrum.

The Government of Bengal poses to open a fully equipped ing school at Serampore, near cutta where weavers and weaving instructors will be trained in all the most useful appliances by a European expert. Smaller branch schools will be opened in several districts in Bengal under the supervision of the expert.

The Government of H. H. the Gaekwar of Baroda is about to open a school for weaving. In Bombay instruction is given at Sir D. M. Petit's School of Industrial Arts, Ahmednagar. Messrs. Shaw Wallace and Co. Calcutta are pre-

pared to fit up Hattersley's looms and to show their working.

The Technological College, Tokio, Japan, gives instruction in weaving. The best weaving school in England is the Yorkshire Technical College, Leeds.

LIST OF LOOMS NOW IN THE MARKET THEIR DESCRIPTIONS, PRICES, ADDRESSES

(1) Hattersley & Sons (English); Parts iron-made. 2 pairs & (by a practised hand) s of cloth (5 yds each piece) : woven in a day of 10 work-ours, threads up to 40 counts woven with and not higher : h the hand and feet used in ng.

chinery rather complicated ot easy of repairs if out of

Price Rs 200 :

(Messrs Shaw Wallace & Co., Calcutta.

(2) Japanese Loom parts wooden. 3 pieces of cloth can be woven in 9 hours : Machinery very simple even a boy can work it and can be put in order by an ordinary carpenter. Price Rs 130 to 150 (Messrs. Khetro Mohan Dey, Radhabazar, Calcutta and Jessop & Co, Calcutta)

(3) Robert Hall & Sons' loom, manufactured at Bury, near Manchester : cloths in width varying from 20s to 120s can be woven, 50 yards, in 8 hours.

(4) *Domestic loom* Hattersley & Co., 50 yds., in 8 hours :

Price Rs. 200 (Messrs Shaw Wallace & Co, Calcutta)

(5) Shafi loom made by Mohomed Safi of Amritsar, Ludhiana.; parts iron & wooden :

25 yds, in 8 hours. Rs 50.—

(6) Dinabandhu Loom special make, by Babu Dinabandhu Mukerjee, retired Railway Engineer, 6 Beparitola Lane, near Wellington Square, Calcutta.

2 pairs a day Price Rs 60.

(7) Jahori Loom : 5 pieces of cloth a day—said to be superior to English and Japanese looms. Price Rs 250 Sizing machine Rs. 50 (6 Brindaban Bose's Lane, Hugalkuria, Calcutta.)

(8) Fly-shuttle hand loom : Ghose, Chowdhry, Palit & Co 40 Harrison Road, Calcutta.

(9) Satyanarayan Banijya Samiti Rs. 45. 26-1 Grey Street, Calcutta.)

(10) A. C. Mullick & Co. (Rs. 35 to 40). 38 Raja Nabakissen's Street, Calcutta.

(11) *Kustea looms*—Cheapest of all 30 to 40 inches length can be woven per hour. Rs 8 to 15.

(The weaving school, Kustea, Bengal.)

WARPING APPARATUS.

Warping Machine warping 120 yds. of thread at one time and capable of supplying warps for 100 Looms the space required for working 10'x12' only.

Price Rs. 150 nett.

LIST OF MACHINES AVAILABLE.

The under mentioned Looms are made to order.

(a) Special Hand-Looms and Power-Looms.

(b) Looms for honey comb towels, napkins and table cloths.

(c) Looms for turkish towels.

(d) Hand-looms with drop boxes for preparing fancy checks etc. These will work with 2 to 6 shuttles at one time.

(e) Dobbie machines.

(f) Sizing machines.

Satya Narain Banijya Samiti, No. 26-1 & 26-2, Grey Street, Calcutta.

JAPAN HANDLOOMS

Manufactured by the Loom Manufacturing Co., Ludhiana.

A net earning of Re 1 per Machine daily.

Suitable for small capitalists, Charitable institutions, Reformatories and Jails.

Guage.	Price.	Weight.	Daily out-turn 40 Cs.
27 inch	Rs. 98	5 mds.	15 yards
45 "	Rs. 130	7	11 "
36 "	Rs. 120	6	13 "
54 "	Rs. 150	8	10 "

Apply to Manager.

BOY'S INVENTION OF A LOOM. REMARKABLE ADVANCE ON ORDINARY FLY-SHUTTLE LOOMS.

At the Agricultural and Industrial Exhibition recently held at Tanjore, a Brahmin boy of 15 N. R. Subramaniam, son of Mr. N. K. Ramaswami Iyer, High Court Vakil, Tanjore, and pupil of the Kalayanasundram High School exhibited an improved fly-shuttle loom. In the ordinary fly-shuttle loom the motion of the healds is determined by the alternate movement of the legs. The shuttle is made to move by pulling [illegible] the other. In the new fly [illegible] exhibited at Tanjore the [illegible] of a wheel determines all th[e] motions. By turning the [illegible] of this wheel the motio[n] healds is effected. The [illegible] attached to a horizontal [illegible] wheel, which turns another wheel placed with its axis vertical, which in its turn, turns another wheel similarly placed, and the motion of these two wheels makes the shuttle move. The turning of the handle also regulates the motion of the reed. This is done by the turning of a small wheel attached to the wheel to which the handle is attached. The warp beam at the end is made to unroll the warp and the clothed beams are also made self-acting by toothed wheels in connection with the

axis of the original wheel. The loom on the new model is called by the inventor, "The Excelsior Fly-Shuttle Loom" and he has applied for a patent under the advice of the Hon'ble Mr. C. J. Weir, I. C. S., who was much struck with the genius of the lad and advised his father to train him in weaving on scientific lines. The Head-master of the Technical School, Karur, Mr. J. W. Mettam, an expert in weaving, examined the loom carefully and thought that it was a very ingenious invention and that it was likely to replace the existing fly-shuttle looms in this The inventor has been a Silver Medal for his

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EST TYPE OF HAND-LOOM.

Mr. Havell s opinion.

Mr. Havell writes to the *Industrial India ;* 20th of September, 1905:—In answer to your inquiry as to the best type of hand-loom for starting hand-loom factories, I write to give you as much information as I can on a point which cannot be answered without discussing a great many other contingencies. As far as present experience goes of improved hand-looms in India I think that for cloths of the finer counts of thread say from 60s. upwards it would be better to take the old-fashioned fly shuttle loom as used at Serampore as this has already been thoroughly tried by thousands of Indian weavers and has been quite successful for weaving saris and dhoties up to counts 120s. Hand factories with these looms should be good paying concerns provided that improved methods of preparing the warp such as are described in my pamphlet on hand loom weaving in India are used also, for it must always be remembered that improved processes for the preparation of the warp are essential for the successful use of improved hand-looms. The other classes of improved looms worked with the foot are quicker than Serampore looms in the coarser count of thread and for narrow widths. Hattersley's ordinary 96 model has turned out 50 yards of coarse cloth No. 8s counts 28 inches wide in a day of 8 hours. They can be used very profitably for all sorts of common jharans, coarse shirtings etc., but they have not been sufficiently tested for finer work with Indian labour but experiments are now being made to compare their outturn with the Serampore in the finer class of work. My advice is to start hand factories with the Serampore looms for dhuties and saries with Japanese Hattersleys and other foot looms for coarse cloth in narrow widths. Have both working together using improved

working apparatus of figured in plate V of my pamphlet which is not too elaborate and can be made in India. The sizing processes should be that used at Serampore i.e. by Mr. Kelkar's machine. His present address is Chinsura Pat, Bangalore city.

I need hardly say that all undertakings of this kind must be managed economically and with business knowledge and sound common sense. Without these the most profitable business will fail. In hand factories started on this plan experience will quickly show whether it will be advisable to increase the number of Serampore looms or of the improved foot looms and which proportion of each will be most profitable."

(b) REPORT OF A SPECIAL EXAMINER DEPUTED BY THE MAYURBHANJ CHIEF

The following extract from the report on the examination of looms etc., at Benares Exhibition and Calcutta, submitted by Babu Kamakshoy Prasad Bose, Assistant Sub-Divisional Officer of Bamanghatty, Mayurbhanj who was deputed for the purpose, we doubt not, will be read with interest :—

The exhibition at Benares (1905) was not such as I had expected. Very few looms had been exhibited there this year. I therefore determined to examine looms in Calcutta also. The following looms I saw working at Benares and I examined them thoroughly.

1. The Sayajee cottage loom from Baroda price Rs. 30.

2. The Punjab hand-loom manufactory's loom prices from Rs. 98 to Rs. 150.

3. Looms from the Madras School of Art.

4. Improved fly-shuttle loom (Srirampore model) Palli Silpasala Calcutta, prices Rs. 45 to Rs 60.

5. Double fly-shuttle loom, Shome and Banerji Chinsura. price Rs 75.

6. B. K. Ghose's loom of [illegible]dernagore.

7. P. N. De, Chinsu[illegible] shuttle loom.

I have also examined [illegible] cutta the following looms.

1. Dinabandhu loom.
2. Japanese loom.
3. Robert Hall & Sons' [illegible]
4. G. Hattersley and Sons' looms.
5. Bankim looms.
6. Jahar Lall Dhar's loom.

1. Of all these looms "The Sayaji cottage loom" of Baroda is the best, both for its work, simplicity of construction and price. It well deserves its names "cottage looms." This loom is constructed in two sections : (a) a special attachment costing Rs. [illegible] by the addition of which to an ordinary loom, the speed of work can be increased three to fo[illegible]

times, (b) A complete cottage loom with the above attachment costs Rs. 30.* This loom is very easy to work and an ordinary weaver can work with ease 100 to 120 picks per minute. In a minute an inch of cloth of fine counts yarn can be woven in this loom. The improvement in this loom upon the Srirampore loom is that its shuttles run by simply drawing the reed towards. No pulling of strings by hand is required. In my opinion this loom should at once be introduced here.

The second in order of mer- e hand loom manufactured : Punjab hand-loom manu- of Lahore. This loom is of make than the Sayajee cot- om but its price is prohibi- far as poor weavers are ied. It might pay well to sh factories with several of ooms and a set of warping eaming machines. The prices of these looms are as follows ;—

27	inches	width	Rs.	98.
31½	"	"	"	110.
36	"	"	"	120.
45	"	"	"	130.
54	"	"	"	150.

Prices of warping machines :—

36	inches	width	Rs.	65.
54	"	"	Rs.	70.

3. Looms from the Madras School of Art, of Palli Shilpasala and P. N. De are the same as the Srirampore "Thak Thaki" loom In these shuttles are run by pulling strings.

4. Double fly-shuttle loom of Shome and Banerji of Chinsura is a clever contrivance. It is the same as the "Thak Thaki" loom. The contrivance is that the looms are placed one above the other and are so arranged that by pulling out one set of strings the shuttles in both the looms are simultaneously made to run. Its price is Rs. 75. But for practical purposes this loom would not be of much use as it would be very difficult for a weaver to look to two looms at once.

5. The loom of B. K. Ghose of Chandernagore is the same as the Japanese loom, but is much too heavier and the price is also more than Rs. 200.

The Calcutta Looms.

1. Dinabandhu loom.—This loom is not yet complete and the maker wants to introduce better arrangements. So far it is on a par with P. N. De's looms. Its price Rs. 60. is also too much.

2. The Japanese looms.—These are much improved looms and unlike the English looms are made of wood, hence easily repairable. So far they are successful with coarser yarns but their price up to Rs. 150 each is rather too much as compared with the Sayajee looms.

3. The looms made by Robert Hall and Sons Bury, Lancashire.

I have seen these looms at Messrs. K. M. De and Co. Radhabazar. Their beams are of wood and other parts of iron. Their prices vary from Rs. 150 to Rs. 300 for looms of 54 inches width. They may be useful for manufacturing purposes, but are not fit for this State.

4. Looms by G. Hattersly and Sons Keighly, Yorkshire, England.—I. corresponded with this firm in 1904. At that time they were making looms up to 40 inch width. But later on they informed me that they had made looms up to 60 inch width but these require two people to work instead of one. So they were useless. Prices for a 40 inch loom was at first Rs. 325. But it has been lowered since. This loom is made entirely of iron and on account of its high speed finer counts than 30s could not be worked in it. It is good for yarns of 10, 12 or 20s. On account of its cost it could not be introduced here. Besides if only one machine is brought it would stand idle for want of quick warping and sizing. Of course the trade of pans here may be almost destroyed by establishing a factory with 20 of these looms with two sets of warping mills. But that is not the goal we drive at. These looms are slow to work at first but by constant practice they are handled better later on.

5. Bankim loom.—This loom I have seen at Calcutta Brindabon Bose's lane. It is the same in principle as the Sayajee cottage loom but the price Rs. 50 is much more. It has just been finished and has not yet been tested.

6. Jahar Lall Dhar's loom.—This loom is made of iron and wood on a Japanese model. Its price Rs. 250 is too much and as it is not better than the Japanese loom, it has no hope of success.

In conclusion I beg to state that as I consider the Sayajee cottage loom to be the loom best suited for this State, I would recommend that your Highness would be so pleased as to sanction sufficient money to purchase one c[illegible] Sayajee cottage loom an[illegible] special attachments for intr[illegible] into this State. These lo[illegible] sold by the Director of [illegible]ture and Industry, Barod[illegible] This State is doing much [illegible] prove the lot of the people [illegible] have established a dyeing [illegible]tion at Baroda and have [illegible] several girls in the exhibition who make excellent laces of all sorts by means of several pins and thread. A visit to the State concerns at Baroda would be most instructive and interesting. Uriya girls could be taught to make laces after a little learning. Spining frames are also being manufactured there with the State help and the weaving school teaches expert weaving.

HAND AND POWER LOOMS FOR INDIA. IMPORTANT TRADE OPINION.

Mr. E. B. Havell sends a letter on the subject of hand and power looms for India received by him from Messrs. Raffael Bros. a well-known firm of loom manufacturers in Manchester. After referring to a series of experiments undertaken by the firm to produce a loom suited in all respects to Indian requirements, the latter says :—

"At last we believe we have [suc]ceeded and we are therefore ... entirely new models which [w]e to have ready in about six weeks' time. So that the close of the year we [pr]obably be able to deal with ...ols of enquiries and orders [ha]ve come round, some of the direct outcome of your [recomm]endation. We know how you are interested in this subject and we therefore deem it advisable to acquaint you with the above circumstances in order that you may advise those with whom you are in touch as they will now not wait very long before a domestic loom will be put on the market as near perfection as it is possible to get. We do not think one can conceive anything more simple and easy-running than the method we have fixed upon, and we shall certainly afford you an early opportunity of judging for yourself of the mistris of the loom in question. Meanwhile we beg leave to mail you apart a copy of our illustrated catalogue of power looms and preparing machinery there is at the present time a keen desire on the part of native firms in Bengal to go in for power-weaving on a small scale and we shall certainly do our utmost to encourage the movement, for we are convinced that sooner or later the bulk of the cloth used by the natives will have to be manufactured on the spot instead of being imported from Lancashire. It is bound to come and we may as well face the question now that so much feeling exists in connection with the partition of Bengal. We have equipped a very small factory for Mr. B. K. Ghose of Chandernagore near Calcutta and would like you to call upon him and examine our make of power-looms they are built expressly for weaving *dhuties*, shirtings etc., and we believe Mr. Ghose is perfectly satisfied with them. At all events, we have repeated orders on hand for him at the present time. Doubtless you will be hearing of others who contemplate erecting small factories of 25, 50 or 100 power looms and if so, you will greatly oblige by mentioning our name for, we know exactly the type of looms suited to the requirements of the Calcutta trade and you will agree that we are by no

no means dear, seeing that we are to day booking orders for 50 reed-space looms complete including all up to date improvements at £13.10s. net packed and delivered free to Calcutta harbour.

NEW MODEL HAND LOOMS OF MESSRS. RAFFAEL BROTHERS.

To The Editor.

Sir,—We had occasion to write you on 7th Dec. 1905 in referance to our New Model Hand Loom, which appeals to Indian Weavers in all parts of the country.

That the subject is one of exceptional interest to your readers is evidenced by the large number of inquiries we have received from commercial firms and private individuals, all of whom appear to recognise the vast scope that exists for the furtherance of cotton manufacturing in India. This applies not alone to Domestic or Cottage Industry, but likewise to Power Weaving.

Hitherto the idea has generally prevailed that it will not pay to go in for manufacturing by power on a moderate scale; this is undoubtedly the case in Lancashire, where the conditions however are altogether different from what obtains in India. We are enabled to say from actual experience that a 25 or 50 Loom Factory properly managed, will yield a very good percentage on the limited outlay involved, say a couple of thousand pounds sterling for a shed of 50 Looms, working capital included.

We have at the present time quite a number of such small Factories to equip in Bengal with our latest High-speed Power Looms and are convinced that the movement will gradually extend in other directions. Your Presidency, in common with Bombay, has everything to gain by encouraging and supporting home industries We shall be only too pleased to deal with bona fide enquiries and to furnish the fullest information on the subject.

Manchester Jan. 19 Raffael.

AMERICAN COTT[illegible] SUCCESSFUL IN BU[illegible]

Experimental cultivati[illegible] five different kinds of A[illegible] upland cotton was tried i[illegible] Upper Burma districts d[illegible] official year 1905-06. I[illegible] yan the results were ve[illegible] factory, while failures were [illegible] from most of the other [illegible] Seeds of the Pernamb[illegible] cotton were distributed to some private persons in the Amherst district, and the results of the cultivation are said to be encouraging. Experiments to improve the indigenous variety of cotton were carried on successfully in the Northern Arakan, Katha and Meiktila districts .Messrs. Finlay Fleming & Co., of Rangoon, have successfully experimented with several well known varities of American cottons in the Myingyan District, where Texas Burr and Caravonica silk were said to be doing especially well.

PART V.

THE FIBRE INDUSTRY

GENERAL NOTES .

Textile Fibres may be defined, in their widest acceptance, as all substances that are capable of being spun, woven or belted. They may be generally classified under two heads, Animal and Vegetable. The animal fibres again may be sub-divided into under two heads, silk and wool, using the terms in their extended sense. Silk of commerce is obtainable from various species of moth or silk-worm and wool from several animals, such as different species of goat , camel, rabbit, &c.

All animal fibres are closely related to one another in chemical composition and belong to the Nitrogenous or Albuminoid group of substances and in composition are intimately related to albumen, gelatine and fibrine. They are insoluble in water or alcohol, but solutions of caustic alkalies cause them to swell up and, if boiled in these, they dissolve with decomposition and the evolution of ammonia. While in the composition of wool sulphur occurs, the nitrogenous constituents of silk, which embrace albumen, gelatine and a peculiar compound called fibroin, are free from that element.

Vegetable fibres also show a similar close relation with one other in respect of their ch[illegible] composition, the basis of th[illegible] being cellulose, a compound [illegible] in ultimate composition to t[illegible] bohydrates, starch and suga[illegible] possessing very marked a[illegible] tinctive characters. In part[illegible] cellulose exhibits a remarka[illegible] difference or resistance to the [illegible] of chemical re-agents which [illegible] allied substances and the [illegible] with which it is associated in growing plants. It is to this power of resisting change that the value of vegetable fibre for textile purposes is due. Vegetable fibres may be divided into three groups or classes, namely,— .

(i) Seed-Hairs, comprising all the different species of cotton.

(ii) Best Fibres of Dicotyledonous plants, under which Jute, all the different kinds of hemp and several other fibres of similar nature may be classed.

(iii) Fibrous Bundles of Mono-otyledonous plants, under which ome Manila-Hemp, Plantain-fibre, gave-fibre, Goir-fibre, &c.

As the demand for the different inds of fibre known in the civi-ised world is daily increasing, bres of novel kinds are coming to he fore.

In India particularly, there are everal species of plants and cree-ers capable of yielding very ood fibre which are unknown in ther parts of the world. For le, one such is the *Sialino's* *vide*, later) which promises possibilities, if taken proper .

vegetable plant known as -finger (*Dhanrosh*) has also und on actual trial to yield ibres. (*vide*, later.)

JUTE

Of all the recognised fibres in India, Jute stands out the first—both regarding usefulness and quan-tity of supply. It is a staple crop throughout northern and eastern Bengal, and, being more paying than other crops, has even supplanted rice, which used to be *the* one great staple crop before, to a very marked extent. It is now practically the only agricultural industry that Bengal has.

Jute is however now confronted with formidable rivals in plantain barks, aloe, sisal, rhea and many other fibre-producing plants and creepers which are rapidly coming to the fore.

ITS TRADE

If tea is practically a monopoly of the cleared jungles of India and Ceylon, jute may be said to be a monopoly of the Bengal delta.

In 1904, Great Britain imported 360,423 tons of raw jute, valued at 63 millions of rupees, and manu-factured jute, the work of Indian coolies, to the value of 33 millions of rupees. Much of the raw and manufactured jute was re-exported. But besides the British purchases, Japan has been buying largely in Calcutta.

The fact that some 40,000 hands are employed at the mills in and around Dundee shows how im-portant is the social aspect of the question there. We might add that jute gives employment to twice that number of people in and about Calcutta and Howrah, and that at least a million of acres on an average are under this extremely profitable crop.

HINTS ON JUTE CULTIVATION

There are certain suggestions made in the Agricultural Ledger, which the growers of jute may try by way of experiment and see the

result :—Cut before flowering and steeped for 14 days, 400 lbs of stalks, 6 feet in length, when washed and the fibre threshed out, yielded 24 lbs. of fibre, fine, soft and silky. Cut just after budding, yield 29 lbs., but inferior to the above. Cut when in flower, yield 24lbs., but coarser than the foregoing. Cut when in pod, steeped for 21 days ; the same result as No. 3. Cut when seed was fully matured and ripe, steeped for 22 days, yielded 26lbs., but quality very inferior.

It will thus be seen that to secure the finest quality the plant must be cut as soon as indication of flowering becomes apparent.

— —

PROGRESS OF COTTON AND JUTE INDUSTRIES

The growth and expansion of cotton and jute manufactures in India is the subject upon which the Finance Minister descants rather lengthily. Indeed, the progress of jute and cotton industry of India stands out in bold relief in an wilderness of general depression and declining trade ; and both the Government and the people of the country have very good reasons to be proud of the success achieved by both. Calcutta-gunnies are not only ousting Dundee from many foreign markets, but are also meeting all home demands. Though cotton is not so profitable as jute we know of cotton mills which pay nearly 20 per cent dividend to their shareholders even today and are always increasing their looms.

The number of looms in the jute factories has increased from less than 10,000 in 1895 to nearly 20,000 to-day. In 1882-3, there were only 62 cotton mills in all India with 1,654,000 spindles and 15,000 looms. Today there are 201 cotton mills in India with 5,164,000 spindles and nearly 45,000 looms. The cotton industry therefore has increased more than three-fold with in the last 20 years. The total capital invested in the Indian cotto[illegible] is estimated at £12,000,000 [illegible] number of operatives empl[illegible] them average 178,500 eve[illegible] The home consumption of cotton is greater than the e[illegible]

JUTE AGAINST COT[illegible]

[*From Mr. Srinath Dutta,* [illegible] *Saran*]

In the course of these 40 years cotton has been ousted by jute from many a district in Bengal. The area of jute can be safely reduced without reducing the profit of the cultivators. If the cultivation of jute be reduced by one third, the price will nearly double, as there is no other country that grows it. even doubling the price it will remain considerably cheaper than woollen cotton, with which it is mixed up for making cloths.

This reduction of the area under ute will be a great blessing to ultivators; they will save the cost f cultivation of this one-third area, while they will get more from two-hirds of the area than what they ow get from the full area.

The area spared out of the pre-ent jute-lands may be devoted to otton cultivation very safely. In Behar, cotton is sown with maize; remains to be seen whether cotton nay not be sown with jute in Bengal. When jute is harvested, otton-plants will begin to grow igorously.

t nobody dream that cotton ig will handsomely pay in l, unless cotton be locally . Owing to competition, the of profit is so small that ailway and steamer freight, ting cotton from Nagpur and ly respectively, may be found ich. Cotton growing is there-re closely connected with cotton pinning. I do, therefore, take he liberty of suggesting that if oint-stock companies for cotton pinnings mill be started in Bengal, half or a third of the capital ought o be in shares of Rs. 10, so that a irge section of the would-be culti-ators of cotton may subscribe or them.

Would you allow me in this onnection to draw the attention of emindars, and, through them, of heir tenants to the fact *that the cotton-seed is very good for cattle* and is very largely used in Behar, for this purpose? It is yielding wealth in Behar, as oil-cake is doing in Bengal. In England* oil is extracted from cotton-seed and the oil-cake is given to cattle. As a food stuff, the seed is, of course, richer than the oil-cake. The Bengali growers of cotton, will have a newly discovered article for feeding their cattle with. And there is nothing else in which cattle will delight so much in Bengal. In this respect too cotton a desirable substitute for jute.

In connection with the above observations of Mr. Datta, the fact has to be taken note of that there is a never-failing demand for *gunnies* all over the world, while jute grows nowhere else except in India.]

A SUBSTITUTE FOR JUTE†

PROPOSED GOVERNMENT EXPERIMENTS

The Board of Agriculture in India has recommended to the Madras authorities that steps should be taken by them to extend the cultivation of what is known as

* *Vide*, article on oil from Cotton Seed, Part III.

† *New jute lands—Vide* pp. 121-124 *ante*.

Bimlipatam jute—*Hibiscus camabunis*—which is an efficient substitute for jute proper, and for which there is already a good demand in the London market. Experiments in the cultivation of jute are also to be continued in certain districts of the Presidency, where they have given some promise of success so far.

RHEA

ITS QUALITIES AND PROSPECTS

A correspondent writes to the "Pioneer" :—As time goes on, planters are becoming more and more sensible to the wonderful qualities contained in rhea and it is confidently predicted that the growing of it will be one of the future industries of Behar. Only experts, and those who have studied the subject, realise the great merits possessed by rhea. It is not only a substitute for cotton, but has been proved superior to it, having capabilities which cotton does not possess. Almost anything can be manufactured from it, from the strongest rope, equal to a hempen one to the finest of silk underwear and its durability is far superior to anything of its kind. Some sceptics maintain that the growing of this plant was attempted before in the district and that it was a failure. But why?—Because, at that time, machinery for the preparation of the fibre was not known and therefore, it was, naturally, a failure. Now machinery has been brought to the required standard of perfection so that only obstacle has been removed. As there is no doubt that, in certain lands rhea thrives splendidly in the district, there is no reason why the growing of it should not prove a complete success. Mr. Jules Karpeles, the well-known indigo broker, is very interested in the subject of rhea and has persuaded many planters to put down plantations. The first experiment was tried at Dalsingh Sarai, unde[r the] able superintendence of M[r.] Coventry, who was the first [to in]troduce the plant to the distric[t] it has proved a most successfu[l] the plant being fine and healt[hy.]

THE RHEA PROBLE[M] SOLVED

A Rochdale Engineer, called Tickel, with the assistance of a local silk-weaver, named Shore, claims to have conquered the gum-difficulty in rhea-fibre. Anyway, he has succeeded in so fully convincing the trade of its worth that a Manchester Company has snapped it up, and paid £20,000 for the secret. The Textile Fabric Company, as the new combination is named, will establish its first mill in Rochdale and intends to com

mence work on a large scale. Mr. Tickel, who will manage the new works, contends that he can deal with either cultivated or uncultivated ramie in such a manner as to leave the fibre absolutely pure and undamaged, and ready for spinning. The specimen produced certainly look very well. They are as white as snow and as soft as silk, and, when manufactured, take on a high finish. Should the discovery realise expectations, a new industry will be brought to Lancashire at a very opportune time, when the shortage of cotton has ...st driven mill-owners and ...s to their wit's end, So says an ...lish paper of 12th May 1905.

... CAMERON ON RHEA

...r. J. Cameron, Superinten... of the Government Gardens, ...published an interesting memo...um on the cultivation of rhea ... plants in Mysore, in the latest issue of the "Gazette." Rhea is said to be domesticated in the coffee districts and Mr. Cameron says that the hill country of Hassan Kadur and Shimoga affords excellent position and climate for a luxuriant growth of rhea. He even says that rhea can easily replace the *Lantana camura*, which is so offensive a growth everywhere. He calculates that, with ordinary care, the average yield per acre is 8 tons of ribbon (striped bark) per annum and that the London price is £10 per ton.—MYSORE STANDARD.

RHEA AS A BY-PRODUCT

INTERESTING REPORT

The following is a Report on the cultivation of rhea, as a by-product to tea, by Mr, W. H. St. J Mildmay of the Luckwan Tea Co. Ld., Sibsagar :—

In regard to the experiment in the cultivation of the fibre-yielding plant, *Boehmeria Nivea*, locally called "rhea," I thoroughly hoed a plot of land, 24 feet wide and 62 feet in length. In this plot, I planted rhea-roots about 16ft., apart, planting square, during May. On the roots giving out shoots, I heavily manured the plot and, during June cut all shoots off (the plant had been very heavily slated by hail and wind) as they were growing very irregularly. I then forked the plants, and in July, cut the stems which had grown with a vigorous and healthy, growth, and procured a local man to clean the stems. The length of the stems when cut, ran in individual cases to between 6 and 7 feet with an average of about 4 feet 6 inches. In this one cutting, the weight of the cleaned fibre that I procured was 14lbs. (weighed after it was thoroughly dried and still warm from exposure to the sun), which works

out to 4 maunds 16 seers to the acre from the one cutting. The cleaning was done very wastefully and was a very laborious undertaking. The length of the staple of fibre was from 2 feet to 3½ feet. I estimate that considerably more fibre could have been produced from the stems, if I had had more efficient means of handling them. But on these figures, we have for five cuttings (I do not think any cuttings could be taken between November and March) a yield per acre per annum of 22 maunds. After the first cutting, the next lot of shoots came on very poorly, growing slowly and without vigour. This I attribute to my not being able to give the plants another dressing of manure, as I was much too pressed for labour. I have since been told that the plant requires shade and that it was owing to the heat, and not to want of manure, that the plant did not grow as before. Personally, I think a heavy dressing of manure would be absolutely necessary between each cutting and very good cultivation of the land.

On a plot, grown under plantain shade, on an area of 171 feet, which had been planted for two years and 3 months previous to the date of cutting, I cut 700 stems, the longest being 9 feet 6 inches, and the average length about 4 feet 6 inches, the shortest being 2 feet 6 inches; the circumference of the thickest stem being 2¼ inches round. According to Karpeles' figures, 100 stems weigh 24 lbs., and Faure's machine gives 3 per cent of clean fibre: therefore, the yield from this small plot was at the rate of 24 maunds 26 seers per acre. Personally, I did not clean them when I cut the stems, in March 1901, as I did not then know how the operation was carried out. The best price I could hear of last year was £40 per ton for clean fibre and as low as £26 to £27 was mentioned. This would not be remuner

I do not think that eve profitable price were obtai owing to the large amou manure required, and also ow the fact that the most vig period of the rhea's grow exactly at the same time that hand is wanted by the tea-g for his cultivation and manufactur-ing of the tea, that this fibre can be produced as a by-product to tea in any large quantities, though, provided a satisfatory price is obtinable, and that it proves feasible to send the fresh cut stems direct to Calcutta to be handled, a small area might prove a useful annual addition to the income of the tea property.

I have sent down to Calcutta some dried stems with a view to ascertain whether or not it is true that the fibre rots, if kept in

the stem. I am also answering some inquiries on the subject of sending stems down, and if the price proves satisfactory or, If I think, anything of service to the community should arise therefrom, I will communicate again tion on the subject.

SISAL HEMP

AN INDUSTRY FOR TEA DISTRICTS

Mr. H. H. Mann, Scientific Officer of the Indian Tea Association, Mr. James Hunter have publi- a pamphlet that should at- the attention of the planters, re on the look out for a pro- e method of utilising waste- The following extracts from amphlet will give an idea of iethods of cultivation of sisal-hemp.

The possibility of utilising in a profitable manner a large part of the lands now lying waste and uncultivated in the Indian tea districts, is one which has been prominently brought before the public on many occasions in the past. In many, if not in most cases, the waste-land is, however, of a type which seems as if it can be better developed by the ordinary ryot-settler, than by the planting community. But when all such land has been settled, there remain vast tracts of country, unsuitable for ordinary native culture, not per haps rich enough for tea unde present conditions, and yet whicl ought to be cultivated, and unde certain crops, are quite capable o being sodone For the developmen of such land the growth of *Agav* and similar fibres, known to commerce as "Sisal-hemp," or "Mauritius-hemp." etc., has been suggested. Now that the market foı these materials seems to have reach ed a fairly stable condition, it is time to con sider by what methods such culture can be carried out what the equipment is required and what are the commercial prospects of a venture like this.

CHARACTERISTICS OF TRUE SISAL-HEMP

The true Sisal-hemp of commerce is known to botanists in twc varieties, named, *Agave rigida* variety—*elongata* and *Agave rigida* variety—*sisalana*, respectively. The former of these is the principal sisal plant of Yucatan, the latter that of the Bahamas. The general opinion seems to be that the *sisalana* variety is the best Plants of the former variety introduced direct into Sylhet from Yucatan have not been very luxuriant and for the Indian tea districts the *sisalana* variety has hitherto, proved to be preferable The variety may be described as possessed of only a very short trunk, with straight stiff leaves from

four to six feet long and four to five inches wide. These leaves have a bloom upon them, giving them a blue tinge, but when this is rubbed off, they are dark green in colour, much greener than the large common blue aloe of the North-West. The edges of the leaves in a typical plant are smooth, without thorns or with thorns, so small as to be hardly noticeable. But this character of thornlessness is an extremely variable one. The young bulbils and plants for the first year of life often, in Sylhet at any rate, show decided thorns on the inside of the leaf, which disappear, or nearly so, as the plant becomes older. Again, it is not at all uncommon for plants raised from bulbils of a thornless plant to possess thorns throughout life, and to be indistinguishable (until the flowering stage) from the Yucatan variety—*Agave rigida*, variety *elongata*. The spine at the tip of the leaf is an exceedingly strong one, often twisted, and purplish back in colour on all the plants.

As regards the best time for planting, February, is considered the ideal month, but there really need be no fear of putting in plants at any time. If put out between November and the end of January, the plants should be large and well grown, in view of the long drought which may possibly follow. Again, one would hardly choose the height of the rains for planting out, especially in steep land, where the rain might loosen the soil before the young Sisal-hemp really gets hold of it, but with a few reservations like this, obvious to a tea-planter, it may be said that Sisal-hemp may be put out at any time of the year, most convenient to the manager of the property.

Growth of a Young

When successfully put out, the young plants should grow about one foot in height per annum. Of course, some plants may grow faster than others, but one foot per a[illegible] at this stage will be about an a[illegible] During this time of growt[illegible] jungle must be kept down car[illegible] If it is allowed to grow up the plants, and then suddenly out, it is probable, as has ha[illegible]ed in our own experience, tha[illegible] shock of sudden exposure [illegible] too much for the plant, the [illegible] existing leaves will die, and a check be given to its growth.

During this time, the true Sisal-hemp plant has several enemies, in Sylhet at any rate. Cattle form one of the worst, and if they are allowed to wander through a young Sisal-hemp garden, they will inevitably put their feet on to, and break the centre out of a number o[f] plants. Not content with breaking the plant in this way, they occasionally pull out the hearts of th[e]

young plants with their teeth, if there is nothing more appetising near at hand. Deer, in places where they abound, also eat out the young leaves. These dangers are, however, soon over, as only the young plants are affected. The big ones are well enough able to protect themselves against cows or any similar animal.

Working a Mature Garden

By the end of the second year, the cultivation of the garden will have become reduced to keeping the ground clean immediately round lants, and to removing any ungle which tends to from in en. From all evidence at at present, it seems advisable ɔ discourage the growth of a rass between the rows. Of , such rank jungle as sun-grass relentlessly be removed. hoeings or weedings per annum appears to be amply sufficient to keep the jungle down in ordinary cases, with more frequent removal of creepers as necessary.

In the third year from putting out, the plants should have attained a height of over four feet, and are big enough to permit of cutting a few leaves. As before explained, the leaves open from a central core and gradually are pushed out from the centre by the growth until they finally reach a position at right angles to the trunk of the plant. In practice, they are considered ready to be cut when they have reached a point forming about half a right angle with the trunk.

Cutting of the leaves may be made at all times of the year, but in the Indian Tea districts, there are strong reasons for limiting this operation practically to the months from October to June. The principal reason is that only at that time, the atmosphere is sufficiently free from saturation, for the fibre to dry in the open air. At other times the necessity for artificial drying increases.

Class of Soil required

Supposing a supply of plant is available, what is the type of land to be used for a Sisal-hemp plantation ?—On this point the most wild and rendom statements have been made. Some have even suggested that the poorer the land, the better is the growth of Sisal-hemp. While, however, this is not in any sense true, it may really be said that the Sisal plant does not require a rich soil. In Yucatan, the conditions are generally very much poorer than are likely to occur in our Indian tea-districts. A few inches of a limestone soil under-laid by limestone rock, represents the usual condition of things.

It may be said from actual Sylhet experience, as well as that obtained in other countries,—

(1) That the first essential for Sisal-hemp culture is a well drained soil. The tea-plant is quite sensitive enough to standing water in the soil, but not nearly to the same extent as the Sisal plant. A water-logged soil means death to Sisal.

(2) That it is equally necessary that the land should be moderately light. The tea-plant flourishes fairly well on a stiff soil, provided it is well drained. With the Sisal, it is not so. The plants quickly become seedy and of no great value as fibre yielders. This is, at any rate, our Sylhet experience.

(3) That too rich a soil leads to very great luxuriance in the plants, but at the same time to a reduced percentage of fibre in the leaf, and that, hence, many of the rank virgin jungle lands of the Brahmaputra and Surma Valleys may be found not to give such economical results as less favoured portions of the tea-districts. Exactly how rich a land may be without interfering with the fibre pertage, has still to be tested, but substantially, it may now be taken that, on the richest lands, there will be a greater percentage (given the same type of plant) of pulp, and a less percentage of fibre.

Time And Mode of Planting

Land for plating should be cleared just as if it was intended to plant-tea. If it has carried bamboos, it is very necessary to see that the roots of these are killed.

In actually planting out, a pit should be dug round every place where a plant is intended to be placed. It is not sufficient to make a hole with a dibble or pointed bamboo, and put in the plant, but the soil round about must be carefully softened by a hoe, four to six inches deep, and the plant placed carefully in the softened soil.

It is very important not to plant too deep. In no case should point of origin of the leaves be covered, as, if this is done, it is most likely that the new leaves will rot they are produced. In fac even important to see that n gets into the inside of the This warning is rather i ance, as the plants are top-heavy, and are made to up so much more easily by stuck well into the ground, that the coolies employed in the work are apt to plant too deep unless carefully watched. If this is done the result will be that in wet weather the plants will get sodden and will rot.

SISAL HEMP CULTURE

Extract

* * There has been so much discussion as to the prospects of Agave fibres in India, and so many

nquiries as to whether Sisal and ther Agave fibers should be cultivated in conjunction with tea-culure, that the two gentlemen (Mr. Harold H. Mann and Mr. Jamer Hunter) decided to embody all the nformations available in a handy orm, and the result is the pamphet before us. It must be stated at the outset that the authors have left out of consideration the botanical aspect of Agaves, about which there is so much confusion at present: they have confined their attention to the purely economic and commercial aspect of the Agave fibre industry in general, e Sisal Hemp (*Agave rigida Sisalaua*) in particular. After a very brief history of s, the authors proceed to a eration of the characteristics true Sisal Hemp, and here valuable measurements are which should help those intending to plant it, to distinguish it from other so-called Sisals. The question of thorns along the edges of the leaf is not disposed of in a satisfactary manner It has been found that the true Sisal may have thorns; and leaves on the same plant have been found with and without thorns Therefore, to say that "the typical *Agava rigida* var. *Sisalane* has *no* prickles on the side of the leaf," is incorrect, at any rate, so far as Indian-grown plants are concerned.

The soil question is one of some importance, and this receives a good deal of attention from the authors, who say—"It may be said from actual Sylhet experience as well as that obtained in other countries—(1) That the first essential for Sisal-hemp culture is a well drained soil. The tea plant is quite sensitive enough to standing water in the soil, but not nearly to the same extent as the Sisal plant. A water-logged soil means dead Sisal. (2) That it is equally necessary that the land should be moderately light as that it should be drained. The tea-plant flourishes fairly well on a stiff soil provided it is well drained. With the Sisal it is not so. The plants quickly become seedy and of no great value as fibre yielders. This is, at any rate, our Sylhet experience. (3) That a too rich soil leads to very great luxuriance in the plants, but at the same time to a reduced percentage of fibre in the leaf, and that hence many of the rank virgin jungle lands of the Brahmaputra and Surma Valleys may be found not to give such economical results as less favoured portions of the tea districts. Exactly how rich a land may be without interfering with the fibre percentage has still to be tested, but substantially it may now be taken that on the richest lands there will be a greater percentage (given the same type o

plant) of pulp, and a less percentage of fibre."

The above accurately represent the soil conditions necessary for the successful culture of Sisal Hemp.

We do not agree with the authors as to the best means of increasing the plant. They quote the opinion of Sir D. Morris in favour of propagation by suckers in preference to bulbils. He says—"I am of opinion that pole-plants (*i. e.*, bulbils), produced as an expiring effort of the parent-plant, are not always calculated to produce such robust plants as suckers. At least, they are not likely to be so when derived from plants whose leaves are poriodically reduced for fibre purposes. It would be well to investigate the matter experimentally. This might be done by planting suckers and pole-plants side by side, and watching the results.". On this the authors observe—"Whatever the ultimate conclusion may be, at present, in the Indian tea-districts, the use of bulbils or pole-plants is inevitable owing to the number required. As each pole gives on the average about 1,200 to 4,000 young plants, it is the only way of getting a large number of young from the few existing established ones. It is probable that the use of bulbils will ultimately be all but entirely given up in favour of suckers." The question is an open one at present, and it is not fair to dogmatise at this stage.

The chapters in planting and working a mature garden are practical and contain all the necessary instructions. Communications and factories are dealt with in a practical way, while the chapter on fibre-extracting machines will be found unusually interesting at the present moment. The merits of the various machines are fully described and some of them illustrated The chapter dealing with the pr[illegible] of the Sisal fibre indus[illegible] perhaps the most important [illegible] commercial man, and we sh[illegible] go into this aspect at prese[illegible] cause we hold decided vie[illegible] the subject.

A FURTHER NOTE

By CHAS. J. GREENGRASS,

PUTTUR, N. ARCOT

The following letter appears in the Madras Mail, with our contemporary's *obiter dicta* :—

"In your leader of the 28th ultimo on 'Sisal Hemp in India' you raise the question as to the

best variety to cultivate, if planting in this time is to be taken up on a large seale. In a previous letter of mine, on the subject, I had advocated the adoption of the species' *Agave Vivipara*' as being, of all the species, naturalised in India. the best fibre producer. This was my experience on experiments carried out on almost all the species at present known in India. Experiments were also carried out on some leaves of the variety 'Sisalana' obtained from the Botanical gardens near Poona with a view to comparing the merits of the two :s. Though the consignment ıves obtained was small, it ufficient for comparision, and rrent the conclusion arrived ıt these two species, *A. vivi-* and *A. Sisalana* were about in this respect. This as re- quantity. In quality, the r, if anything, had the advan- the fibre being longer and of finer texture and of equal strength.

From what I can make out from your article, Mr. Mann and Mr. Hunter do not seem to have paid any particular attention to this species of aloe, but to have devoted their experiments more to the testing of the American plant.* This latter is placed by these gentleman as "far ahead of any," with the blue aloe occupying an honourable place. Messrs. Mann and Hunter placed *Furcraea*, not the blue aloe, next to the Sisal varieties. I am quite sure, as I have found the latter very inferior as a fibre producer compared with *A. vivipara*, that if this plant had been properly tested, they would be of the same opinion as myself. Another point, and a very material one, in favour of the *A. vivipara* is the fact that it is already naturalised in India, and can be procured in large quantities near at hand, and at a fraction of the cost of the other; so that, *cæteris paribus*, I think, it would be unwise to discard a species that has already taken kindly to the Indian soil and climate for one which is exotic and the behaviour of which is conjectural, when planted on a large scale in this country whatever may be its merits in other lands. My advice would therefore be that, planters who intend going in for this industry, should utilise the facilities near their doors instead of going further afield. This especially to those who have but a moderate capital. Experiments could, of course, be also carried out with the American species on a gradually extending scale, when, if the latter has proved itself worthy of the preference, it could be substituted for the others without any risk, hav-

* All the ayages are natives of America.—Ed.

ing in the meantime a species to depend upon, which is sure not to play them any tricks.

The *A. vivipara* is found throughout the Deccan where the natives manufacture rope out of its fibre. The Mahrattas call it *ghyle*, and only the non-caste Hindus, the Dheds and Mangs work it. The latter are one of the criminal classes of the Deccan, and when not engaged in robbery, they employ their time in manufacturing fibre and rope from this plant. Their methods are primitive. The leaves or blades are cut with a hooked knife. This knife is then run along the two edges to clear the small crooked thorns, and the end spike cut off. The leaf is then split up into ribbons and tied in bundles. These bundles are then soaked in any neighbouring stream for seven days, by which time they have rotted. The next process is to beat out the rotted leaves on stones with a wooden mallet, which gets rid of the flesh, leaving the fibre. This method, I need not say, injures the fibre considerably, and the consignment sent to Liverpool fetched only £ 11 per ton, when Sisal-hemp was commanding £ 20 *sic.* the latter machine-cleaned. This, however, was no criterion of their relative merits, as a sample of the fibre cleaned with a knife was pronounced in England to be as equal in quality to Sisal.

PRICES OF SISAL AND MANIAL HEMP

ENGLISHMAN, MARCH 1906.

Of 487 bales Indian Sisal, 184 sold at £ 16-10 s. to £ 30.

At yesterday's auctions, 831 bales of Manila were offered and 85 sold at £ 38-10 s. to £ 39-10 s., c f and i. Of 168 bales Mauritius, 41 sold at £ 28 to £ 30. Of 11 bales Bombay, 4 sold at £ 15-5 s. to £ 16-15 s. 57 bales Jubbelpore, 214 bales Allahabad Sunn, 190 bales Bengal Sunn and 56 bales Sanseviera were bought in.

EUROPEAN ENTERPRISE IN THE C. P.

European enterprise is taking up the cultivation Sisal Hemp plant in the Central Provinces. The authorities are leasing a large area of land in certain forest reserves in the Sambalpur district for the purpose.

SISAL FIBRE IN SOUTHERN INDIA

In regard to sisal fibre cultivation in Western and Southern India, we learn that the Mysore State Gardens are doing a big busi-

ness in the supply of plants of *Agave rigida* for which there is an increasing demand. The gardens sent out 45,000 plants last year, and expected to have an equal number available this year against which they already had a single order for 100,000 plants. This is satisfactory evidence that the industry must be making great headway in Southern India. Among other public demands on the gardens is that for seed of the American Sumach or *Divi-Divi*—a valuable tanning agent—of which large quantities of seed are being sent

Rhea, Black Peruvian Cotton Manila Hemp are all under at the gardens and promise :n out well.

SISAL SEEDLINGS

The Secretary of the Assam Branch of the Indian Tea Association notifies that seedlings and suckers of sisal fibre plant may be obtained from Mr. J. C. H. Mitchell, Balipara P. O., Tezpur.

ALOE OR AGAVE FIBRE

From The Market Report

At the present time the demand for all kinds of good and strong fibre, is so great that it may not be an exageration to say that attempts are being made all over the civilised world to discover some kind of good and strong fibre which may be used for spinning, weaving or rope-making purposes, and the discoverer is sure to make a fortune for himself. Almost all the fibre bearing plants, trees, and crepers are being constantly experimented upon by all interested persons all over the world and specially in India where such plants are found in abundance. Of the various kinds of plants found to contain valuable fibre in India, the following may be taken as the most important, namely,—Agave; plantain, pineapple, rhea, &c. &c., and all of these may be taken up with a very small capital but yielding large profit. In fact, the above plants may be grown with only a nominal outlay which may even be within the means of middle class people, and as the demand is unlimited, permanant and ever-increasing, one can easily make his fortune in a few years, out of any of the above industries.

Of all the above, special attention is now being paid to the Agave or Aloe fibre which has at last been extracted successfully ond at cost which may leave a very handsome margin for any one who cares to take it up.

Agave is a plant which grows nearly all over the world and speci-

ally very largely in America. This plant is found growing wild in many parts of India also, but it was not a native of India. It is said that the Portuguese, when they had their settlement at Chinsurah, brought out this plant from America and planted all round their gardens as a sort of hedge to keep out the cattle from the gardens. Gradually from its use by other persons for the same purpose, it has now spread itself nearly all over India. Most probably its wide distribution all over India is greatly due to the Railway Companies, they having also made use of this plant as hedges, as extra precaution for preventing domestic cattle or wild animals from straying into their lines, over and above the wire fencing on both sides of their lines. Much thanks are therefore due to the Railway Companies for their helping the growth of this most useful plant, though with very little knowledge of its usefulness and never for a moment thinking that there is a great future awaiting this most insignificant looking wild plant.

For hundreds of miles these plants may be found growing on both sides of the East Indian, the Oudh and Rohilkhund and other Railway lines forming most formidable second hedges of their lines and in Oudh and its surrounding provinces it grows wild over large tracts of land.

The leaves of this plant are very juicy and are as much as 6 to 7 ft. in length when [illegible]. These leaves contain [illegible] most valuable fibres [illegible] world as the Aloe fibre, [illegible] there is now very great [illegible] over the civilised world and [illegible]ally in England. This plant [illegible]sists of a root, out of which many suckers come out making it look like a huge spider with more numerous feet than found in Nature, and leaves which shoot up in luxuriant growth from the top of the root.

Each of the suckers c[illegible] out of the root, as described [illegible] generally takes to the groun[illegible] gradually becomes the roo[illegible] separate plant. Thus to gro[illegible] plants, one has only to c[illegible] suckers off from any one [illegible] plants and plant it somewhe[illegible] on the ground and in due course, the plant will grow. Thus, from one such plant thousands may be easily grown in two or three years.

As is described above, the leaves are very juicy and therefore the proportion in weight of the raw leaves to the ready fibre is nearly 5 to 1, or in plain language it is necessary to cut 5 mds. of leaves to get 1 maund of ready fibre.

The leaves are thick, inside [illegible]ing full of juice and outside [illegible] fibre. To take fibre out of [illegible]

leaves, the juice must first be thoroughly taken out and then the green parts of the leaves, when the fibres come out, which must be carefully and thoroughly washed to take off the gummy portion. The fine, silky, white and strong fibres are thus obtained way and are commercially sold as Aloe fibre. The longer and whiter the fibre, the more valuable it is. At Calcutta, the best quality may fetch as high as Rs. 12 to 13 per maund and Rs. 6 per maund for the lowest. Extra fine lots may fetch as much as Rs. 16 per maund, with imited demand for all the at qualities upto any quanhatever may it be.

give below a statement of rom which it will appear that s ample margin for any one it up and invest his capital, by the by, is very insignifi ant.

We shall give here the cost per maund of fibre, provided the grower has taken up at least 50 *bighas* of land for its cultivation. If done on a smaller scale, it does not pay. In a village, plots of land where no other crop can be grown, highlands which now generally are the most jungly portions of villages, and such other neglected parts may be taken lease of at a very low rental from the zemindars and this plant may be grown. The plant may grow anywhere, provided it gets plenty of sun and fresh air. There is no necessity either to till or manure the ground in any particular way or to keep up a free and constant supply of water for its growth. The plant, which does not generally send its suckers or roots too deep into the ground to draw water or moisture from it, possesses a special power to draw sufficient moisture from the atmosphere through the leaves for its maintenance. It is for this reason only that the suckers, at least a good number of them, may be cut off from the root without in any way affecting the plant itself.

To grow the Aloe or Agave plant, it is necessary to only dig about 1 ft. square and about 1 feet deep holes on the ground, only to loosen the earth and then the suckers are placed in the holes with a small amount of loose earth over them. For a short time or until the first shoot comes out from the ground, it is necessary to sprinkle water from time to time, and to see that it is not destroyed (which is very scarcely the case) by any insects or animals. When once the plant begins to grow, it scarcely has been found to die; but all the same, the grower must carefully watch the plants, till they are big enough to suck their subsistence from the ground or atmosphere. They must be planted at least 6 ft. apart, if not more.

Thus we can grow, in a *bigha* of land, about 400 plants easily. Taking each plant to give about 4 seer of clean fibre in a year at the lowest, we get in a *bigha* of land about 40 maunds of fibre in a year. Taking again that the fibre thus produced is the lowest possible quality and does not fetch more than the lowest value paid for it, say, Rs. 9 per maund, still the gross return per *bigha* of land will be Rs. 240 a year. But, if only a little extra care is taken, a *bigha* of land may yield more than 40 maunds and the quality also may be much better and may fetch as high as Rs 12, or even Rs. 16 per maund (the latter rate, of course, is very rare and only exceptionally good quality of fibre fetches such a high price) in which case the gross outturn may be as high as Rs. 500 per *bigha*. The cost of production and other costs to send it down to the Calcutta market, all put together forms only a fractional part of what may be obtained for it, as will be found from the table given below, and will leave a clear profit of many hundred per cent. on the capital outlay. At a hard time like the present, people eagerly invest their hoarded wealth in Government Securities on 3 or 3½ per cent interest per annum, and therefore, it hears like a fairy tale to learn that there is a trade which may yield as much as five hundred per cent or more on their capital outlay. It is a pity that our countrymen, with such splendid opportunities for employing themselves, their capital and their own poor countrymen, look for wretched service under merchants or the Government. They can in a small way start the trade in Aloe fibre, if they can only put together such a small sum as Rs. 500 or thereabouts and gradually can invest more and more in it as they gather their profit every year.

Note—This is merely an estimate. The actual outtern may of course exceed or fall short of this, according to circumstances.

Memo. of Cost per bigha, t
at least 50 bighas of lan

	R
Rent for one year for 1 *bigha* of unproductive high land, at the highest. [But such lands may be obtained at such low rate as 2 annas per *bigha*. We take the highest possible figure, only to avoid all possible doubts from the minds of the intending investors]	
40 men for the purpose of digging 400 holes in the ground, each measuring 1 ft. square and 2 ft. deep, taking each man to be able to dig 10 such holes in a day, at the lowest and taking the wages of each men at 4 ans. per day ...	10 0
10 men for planting 400 suckers in 400 holes at the rate of 40 per day per head and the wages at 4 ans. per head ...	2 8
Supervision of the plants till they grow sufficiently high to support themselves and watering the same, at the rate of 1 man for every 10 *bighas*, taking his wages at the rate of Rs. 8 per month or Rs. 96 a year, and therefore the cost per *bigha* is in an average per year...	

Note—The cost of the seedlings is not taken into account. The plants grow wild and can be collected with a little effort and nominal expense. If they are to be paid for at all, Rs. 3 to Rs5 per 100 may be put down on this head, for purposes of the estimate.

Thus the cost of growing the plants per *bighà*, which yields 40 maunds of fibre as has been shown above, is about Rs. 23 and therefore the cost per maund comes to about Re 0-9-6 or a little less. Then, of course, comes the cost of extracting fibre from the leaves, which no doubt is the highest item of all the expenditures on this head.

res may be extracted either id-labour or by machinery. done by hand, it takes more id costs more and at the me the fibres. obtained are clean as those done by ery. A new kind of machi- will shortly be imported l be working the fibre which an and extract fibre at about 12 Ans. per maund, or thereabouts. The railway-freight, even from the farthest corner of which Calcutta is the centre, to Howrah or to any other Calcutta station, cannot be more than 12 annas per maund, at the highest. The cost of production and railway-freight put together does not, therefore, exceed at the highest, Re. 1-8-0 per maund. Add to it the cost of growing the plants as given above, which is Re. 0-9-6 per maund. Thus all the costs from beginning to the end, i. e., till the time it is put in the Calcutta market for sale is Rs. 2-1-6, or say, nearly Rs. 2 per maund. If cleaned by hand the cost comes to be a little less, but the machine-cleaned fibre is much cleaner than the hand-cleaned fibre and fetches at the lowest Rs. 10 per maund, thus leaving to the grower a clear profit of Rs. 8 per maund or Rs. 320 per *bigha* which is equal to 400 per cent. on the capital outlay.

This trade is specially suitable for the Indigo and Tea planters and large landholders. Indigo planters who own large plots of land, may most profitably take to this trade, which is sure to give them a much larger profit than what they could get for their Indigo, even in its best days. Indigo is a dying industry, whereas trade in Aloe fibre is a new and most promising one. Aloe plantation is exactly suited to them which will prove, in near future, to be a more profitable trade than their indigo. Tea-planters also who have large tracts of land, which they do not know how to utilise, if they grow Aloe on their spare lands, they will get a very fair additional profit which will be nearly four hundred per cent. on the amount they will invest in it. We can, therefore, draw their special attention to this most valuable plantation.

Regarding the highest quantity of fibre obtainable per acre, it may be said that so much as 40 maunds may be obtained per year, per *bigha* (a little less than one-third of an acre.) Thus an acre may yield about 5 tons a year. This may seem to be an absurd figure and in the opinion of many, an acre cannot yield more than about half a ton of fibre, at the highest.

The plants may grow and grow vigorously and luxuriously, if they are planted 2 yards apart. Most of us have seen Aloe plant growing luxuriously on the railway sides, close to the other without any space between. When planting, the growers need not take any extra care for the plants, which will grow themselves. They must consider it to be a wild plant and allow Nature to have full play; any extra care may serve quite the opposite purpose. The reason of our fixing two yards as being the intervening space between two plants, is that, if grown in this manner, the plants may be very carefully examined each and all, and the plantation itself looks very nice and clean. A *bigha* of land is 40 yards long by 40 yards broad or 1600 square yards in area. Thus, if planted 2 yards apart, there would be 400 plants in each *bigha* or 1600 square yards of land. After a few years, (say 3 or 4) when the plants are full-grown, one may easily get about 4 seers of fibre from each plant in a year and the yield of 40 maunds per *bigha* per year is not after all an ideal figure.

Of course, 40 maunds is the highest yield, but 20 maunds per *bigha* or 1600 sq. yards may be safely put down as the average return.

It must be clearly understood that these plants do not like much water. The principal part of their nourishment they draw from the atmosphere through their long leaves, roots being only the secondary means in the matter of supplying the necessities of
Such being the case, one may
ly dispense with water, as soc
the plants grow a little, th
when the suckers take roo
begin to shoot out leaves.
too much saturated with
instead of helping the growth
kill the plants. High and dry lands are always preferable to low marshy ground.

ALOE CULTIVATION IN MADRAS

A new industry has been commenced at Yercaund in Madras in the shape of fibre cultivation. For the last seven years, a small private company has been working the Prieaux Verts estate and planting out coffee. In view, however, of

the recent depression of coffee prices, the proprietors resolved to open out the remainder with the *Fourcroya Giguntea* aloe, a species of Agave which grows here naturally, and attains a very large size, some of the leaves being as much as from nine to ten feet in length. It is a much handsomer and larger plant than the ordinary railway aloe, and is of a dark green colour. If untouched, it generally flowers in about 11 to 12 years, but when cut, it lasts several years longer. There are many aloe bushes here 15 years old, which, g their growth, have had 150 to 200 leaves, and which quite 12 ft. high, spreading ieir broad, spiked leaves all with almost mathematical iion. About five years ago, :ompany opened out a block s aloe of 40 acres in extent, planting five by five, or about 1,500 to the acre. The plants having now reached a considerable size, are ready for treatment and a quantity of machinery has been obtained from England for working them. The cultivation of the aloe is very simple and inexpensive. When the tree sends up its long shoot 20 30 ft. high, it is covered with flowers, which turn into bubs, of which large clusters hang from the shoot. When this dies and falls, the bubs take root in the ground and grow up of their own accord. It is only necessary to dig these up, to put them into nurseries, and then transplant them. The holes required are small, and there is no expense for weeding or manuring. During the first two or three years, the weeds are cut down once a year at a cost of about Re. 1-8 per acre. After that the plants more or less weed themselves, and are ready to be treated after the fifth year. Only a few leaves are cut each year from the bush, and it is calculated that, cutting ten leaves annually the process may go on for ten years. The great drawback to the successful cultivation of the aloe Agave hitherto has been the enormous cost of the carriage of the leaf. The *Fourcroya Gigantea*, the largest of the species, does not grow so well on the plains as it does at an elevation of 4,000 to 5,000 feet. Hitherto experiments on the plains have been confined to the Brazilian aloe, which grows so luxuriantly in the railway hedges. In many parts of the Madras Presidency, especially in Berilly and the Ceded Districts, this aloe grows wild, scattered over waste tracts and planted by the sides of roads. Now, the aloe leaf is large and heavy, but contains only a very small proportion (3 per cent. is high) of the fibre to the weight of the leaf. If therefore, the leaf is picked up all over the country as

it grows, and carried several miles to the mill, the cost of production is so heavy that there is little margin left for a profit. Still, even under such circumstances, a profit can be made. The great object is to get the cost of carriage reduced to a minimum. The Madras Fibre Company, one of the Directors of which, by the way, is a resident of Yercaud, is at present working the aloe in the above expensive manner, but it is also planting out several thousand acres systematically. Of course, some years must elapse before these plantations are sufficiently mature for treatment.

EXPERIMENT AT THE HINDUPUR FARM

Some very interesting experiments were conducted at the Hindupur Farm in extracting Agave fibre. Leaves weighing 3,542lbs. were collected, washed, beaten and the fibre separated from the green mass by employing in all, 95 adult males and 23 boys. The quantity yielded 105½ lbs. of clean fibre, and cost, in labour, Rs. 19-14-6. On this basis, 2,240 men are required at 3 annas per day, to produce one ton of fibre. Mr. Benson's opinion on the remunerative character of the industry is that it can be worked only as a by-product by the ryots in the "off season." The use of machinery, of course, connotes large supplies of leaves at suitable centres.

A TEA-GARDEN MANAGER'S OPINION

"There is only a little of aloe plantation in India just now. There is one plantation in Bombay, one in Madras, one in Sylhet, one in Ranchi and one in Tirhoot. Seeing the large profits that are people are taking to its plan all over the country.

(*a*) Exposed high grou suitable, a damp soil will not this plant.

(*b*) Aloe, planted on cleared hilly land, will grow well.

(*c*) If planted 8′ by 8′, an acr of land will cover 1362 plants. by 8′ is a suitable distance. 85 acres of our garden are plante like this. 10′ by 10′ would be a unnecessarily big gap.

(*d*) The leaves mature for treat ment after the fifth year and go o till the eighth. The leaves are cu twice a year and at every cutting a plant yields 30 to 35 leaves.

After the eighth year, a po comes out and the plant dies and

new plant has to be put in the site thus vacated.

(e) I devised a machine which extracted fibre beautifully, but its outturn being small, the expenses are not met.

In March last year, I had been to see the working of a machine in Daurachira tea-garden in Sylhet. There I saw the "Pioneer Iron Co's Fibre Machine" which extracts fibre out of 8000 to 10000 leaves in an hour. Price of the machine is Rs. 10,000 and the motive engine Rs. 9000.

) There are 3 machines by Suter, price ranging from 500 to 5000. The outturn is ratively less than the above ne.

There is quite a variety of ommonly known :—

Agave Sisalana

(ii) „ *Elongata*

The fibre of these species is valued at £30 to £37 per ton in London.

The seedlings 6 inches to 1 ft. can be had at Rs. 10 to 12-8-0 per 100.

(iii) *Agave Rigids*

(iv) „ *Fourcroya*

Common in the Ranchi district Chota Nagpur. The seedlings are cheap, about 1000 being available for a rupee. The fibre of the *Rigida* variety sells for Rs. 7 per maund delivered at Howrah, Rs. 10 to 15 per maund in London. This is the variety ordinary put in as hedgings round Jail-compounds.

(v) *Agave Gigantia*

(vi „ *Vivipara*

(vii) „ *Banod Vearah Zelaniker* known in vernacular as '*Surch mukhi*' (needle-pointed). The fibre is very preceious.

(h) No special treatment of the soil or plantation is necessary. Only care has to be taken for some time, to see that the plants while young, are nor damaged by cattle or overgrown with jungles.

Irrigation is unnecessary and the plantation is a very cheap business. If the land is free from jungle, the plants have to be simply planted diagonally about 8 ft apart, thus,—

*   *   *   *   *   *

  *   *   *   *   *

*   *   *   *   *   *

either upon raised banks or mounds 1½ ft high or in pits dug. That is all. The cost of plantation is scarcely Rs. 2 or 3 per acre."

AGAVE HEMP FIBRES

RECENT CORRESPONDENCE IN THE 'ENGLISHMAN.'

A good deal of interest seems to have been excited in the short editorial paragraph that appeared

in the "Englishman" a few days ago. It may, therefore, not be out of place to go into some detail on the subject of hemp fibres generally and how the fibre industry may be developed on a commercial scale in India. The paragraph referred to above is quite correct, but details are wanting, which I propose to supply here.

What is known in the trade as "Aloe" fibre, or under the general term of "Hemp", is the produce of several species of a genus of plants known botanically as *Agave.* These plants belong to the extensive Natural order *Amaryllideæ,* and are natives chiefly of tropical America. Mexico, Florida, California and the "Gulf region" generally seem to be the natural home of these plants. From these centres, they appear to have been widely distributed. The majority of the *Agaves* are what we in India would describe as "hardy" plants; that is, they will thrive, grow, flower and increase under conditions of soil and climate that would kill most things. For instance, the drier the climate, the better they thrive, that is, from a commercial point of view. Poor gravelly soil will suit them just as well as a rich loamy soil. If there is no rain for months, it makes no difference to certain species of Agaves that are found growing in India as if they were indigenous to this country. Indeed, I am inclined to the belief that a good many of the Agaves found in India are really indigenous, and are not importations, as some authorities appear to think. The general idea is that all our Agaves have been imported at some time or other. I dissent from this view, because I have found plants growing in places where it seems impossible to have imported them. For instance, going up the Western Ghats from Satara, on reaching mile 27, the eye catches a glimpse of hundreds of thousands of a species of Agave growing wild under an overhanging some 3,500 feet above sea The question I asked myself "How did those Agaves get t With great difficulty, I got specimens, and on close exa tion failed to identify the with any known species. leaves were narrow uniformly, like the leaves of a pineapple, about 5 feet long, and with fibre of very fine quality. I mention this in order to show that there are species of Agave in India, which I believe to be purely natives of this country.

Of the species and varieties now used for their fibre in India, the following are the more important *jats*:—

(1) *Hgave rigida,* (var. *Sisalana.*) This is the plant that yields the well-known "Sisal Hemp" of commerce. There is a large plantation

of it in Sylhet, owned by the Dauracherra Fibre Co., Ld. Some tea estates in Sylhet, notably rhe Baraoora Tea Co., Deanstone, and Sathgao Tea-Estates, are planting out several hundred acres of Sisal, which may be expected to come into bearing in a couple of years. The fibre of the true Sisal is very coarse, and is the strongest of all the Agaves. It is taking the place of Manila Hemp (which is the produce of a plantain, "*Musa textilis*") and is a native of Yucatan in Mexico. It grows very well in India, but is not exactly "hardy", in-as-much-as it requires irrigation, from drought and is killed t. Add to this the fact that ble to the attacks of fun- seases and insects. Not long ie Superintendent of the imet Botanical Gardens, npur, drew attention to this, and said that the plants sent out from those gardens were free from disease. The Sisal does best planted in good soil, having six feet space between each plant, and seven feet between each row, or say 600 plants to the acre. The yield of fibre is about 4 per cent. to the weight of the leaves, or about half a ton to the acre. A plantation of 590 acres would thus give 250 tons of fibre, which, if properly cleaned, dried and carefully baled, would sell at about £32 per ton, equal to £8,000. The "bulbils" cost to import about Rs. 60 per 1,000. The percentage of casualties is about 20, so I calculate Rs. 60 per acre for the bulbils or Rs. 3,000 for the plants for a 500 acre plantation. Clearing, levelling and planting out cost about Rs. 5 per acre, and the rent of land Rs. 500. The initial outlay for the first year would be Rs. 6,000. Thereafter, there is the upkeep, irrigation and watch and ward. These may be roughly calculated at Rs. 1,000 a year. So that the plantation would in round numbers, cost Rs. 8,000. The machinery, including two decorticating machines, (turning out a ton of fibre a day), engine, boiler, baling press, and sundries, would cost about Rs. 20,000; a factory, building, bungalow for manager, etc., about Rs. 5,000. The total outlay would be roughly Rs. 35,000. I am, of course, calculating for a factory apart from a tea-estate. Estimating the outturn of fibre at 250 tons, realizing £8,000, or Rs. 1,20,000, and deducting therefrom 25 per cent. for working expenses and other charges, including freight, etc., to London, the profit works out at Rs. 90,000 a year; from which must be deducted interest on capital and depreciation at 12 per cent. for two years, equal to Rs. 8,400, leaving a net profit in round numbers, say, of Rs. 80,000 a year. This is, it seems to me, a good-enough investment.

2. *Agave vivigara.* This is the "Bombay Aloe", the fibre of which is finer and weaker than that of Sisal. But the plant is very hardy, and stands drought and frost. The fibre realizes from £25 £27 per ton, c.i.f. London. There is a strong demand for this fibre in London and on the Continent, chiefly for binder twine manufacture. It has also been used in textile manufactures on the Continent. Being naturalized in India, the "bulbils" and "sackers" of this species can be had cheaply, and a plantation would cost about half that of Sisal. All other expenses would be about the same as for Sisal, except that no artificial irrigation would be needed. The percentage of fibre to weight of leaf is about 2½ to 3 per cent.

3. *Agave S.*, species No. 1. This is a variety found growing in a wild state in the Dun Valley. The leaves are of great size, often measuring 8 feet in length, The fibre is of very superior quality, beautifully white, with a fine gloss. London and Hamburg buyers are ready to take any quantity at £34 per ton. The fibre is not quite as strong as that of Sisal, being finer in texture; and is used not only for ropes, cables and binder twine, but for textile purposes. The samples of cloth made from this fibre look like "mercerised" silk fabries. This is the species I recommended all intending planters to select. It stands drought and frost equally well. The Sisal plants intermixed with it were killed out by frost and drought.

4. *Agave S.*, species No. 2. This is a totally different plant to the last named, and resembles the *Agave elongata* of Mexico. The leaves are long, narrow, (with spines along the edges), about 5 feet in length and 2½ inches wide. The fibre of this species is even superior in quality to that of the last named. It is smooth, long, silky, very strong, with a beautiful gloss. London and Hambur
ers are ready to take any qu
at £35 per ton, c.i.f. In pl
out, 800 plants go to the ac
is a native of the United Pro
and is to be met with all ov
Dun Valley.

6. *Fourcroya gigantea.*
is the plant "Aloe" so commonly planted along lines of Railways in India. The fibre is very white, with a fair gloss, not as long as the last named, being seldom more than four feet in length. It is not very strong; but is good enough for binder twine and "white ropes". The percentage of fibre is about 4 to weight of leaves. I saw a contract recently with a Hamburg firm for this fibre at £27 per ton. The plant is very hardy; n
but fire will kill it. Insects
kinds give it a wide berth.

white ants and the omnivorous goat will not touch it. Not more than 600 plants to the acre can be planted, as its habit of growth is spreading.

6. *Fourcryoa giganta* This is the plant that yields the "Mauritius Hemp" of commerce. It is a totally different plant to the Agaves the leaves being thin in texture, of a pale green, with immense thorns along the edges. The fibre is fine, not as strong as any of the foregoing, and is valued at about £22 per ton. I do not recommend this for planting in especially as the percentage e to weight of leaves seldom is 2 per cent. The plant is eading habit, the leaves are 8 to 9 feet in length, and are danger to coolies cutting it. ore than 500 plants go to an

Having described the species of Agave commonly grown in India, I have only to add that, with capital at hand, a plantation of five or six thousand acres should be put down, from which the profit will be very large. But the first point to consider is to secure the services of a man who understands his business, and who is reliable. I know two concerns that lost heavily in the beginning by having engaged unsatisfactory men to run the show.

The great drawback hitherto to the taking up of Agave fibre manufacture was the absence of a really workable decorticating machine. This has now been got over, and there is nothing to prevent a hundred Agave plantations being laid down. The demand for the fibre exceeds the supply; and, as the editorial in the "Englishman" pointed out, once let the trade at home and on the Continent understand that a continuity of supply of Agave fibre from India can be guaranteed, and a very profitable industry will soon become established.

June, 1906 X.

AGAVE HEMP

TO THE EDITOR OF THE "ENGLISHMAN"

SIR,—It is to be regretted that that your correspondent "X" writing on Agave Hemp in your issue of 19th June has been so inaccurate in the details which he said wanting in your short interesting Editorial of a previous date.

His article would be highly gratifying to all concerned in fibre were it correct, but unfortunately, even a glance at his figures relating to the Sisal variety suffices to show that one can place no value or reliance on his statement, which

are so full of errors that they are useless for all practical purposes.

It is a pity that "X" did not mention the district in which he gained his experience. Conditions vary very much in different parts of India and can account for differences of opinion, but scarcely for "X's" erroneous calculations.

Those I refer to are:—

1. Planting 6 ft. by 7 ft. (rectangular) gives 1,037 to the acre, not 600, as "X" states.

2. 500 acres at Rs. 60 equal to Rs. 30,000, not Rs. 3,000.

3. The "initial outlay" should be Rs. 33,000 not Rs. 6,000.

4. The "cost of plantation in round numbers" should be Rs, 35,000 not Rs. 8,000.

5. The "total outlay" should be Rs. 60,000, not Rs. 35,000, and, so on.

And the profit he makes is prodigious! Conditions, as I have said before, vary; so "X" allows only Rs. 5 per acre for "clearing leveling and planting." Rs. 5 for clearing alone, is a fair average in most places, and would not go far in forest jungle. Rs. 10 or Rs. 12 is a safer average estimate for the lot to make a fair job. He allows nothing for cultivation, or for keeping down jungle and weeds during the first year, but perhaps they don't grow in his locality!

In "X's" locality too, one may be able to open up an estate without having to import a house, and be responsible for the health of labour, as he allows for no outlay in this connection.

He allows for a manager's bungalow, but not a pice for the salary of the "man who understands his business, and who is reliable." He makes no provision for roadways, which are indispensable, nor for nurseries which may be regarded as the *sine qna non* of a budding estate of Sisal or anything else. To plant small out in the open clearing alike to the bulbils and th of those who invest in them

"X's" mistakes are ma I shall just finish by asking what part of the wide-worl yields half a ton of fibre years' old.

Sylhet FIBRE-PLANTER

PINEAPPLE FIBRE

The Bureau of Agriculture of the Philippines in a recent report writes of the fibre of the pineapple, which is widely distributed throughout the Philippines, being cultivated in some localities for its fruit and in others for the production of fibre. The plant does not thrive in wet soils, but is best

apted to a porous, well-drained soil and is capable of withstanding protracted drought. It is generally propagated by means of the suckers which arise from the parent-plant, near the ground, but can also be reproduced by means of ships. When the plant is being grown for its fibre, the fruit is removed soon after flowering has taken place, in order that the leaves may develop more freely. The fibre is thus extracted:—The epidermis of the leaves is first removed by means of a blunt iron or wooden scraper. [redacted] r of fibre is thus exposed [redacted] ifted with the fingers or a [redacted] patula. The scraping is [redacted] eated and a second layer [redacted] is exposed, which is in turn [redacted]. This process is contiuued [redacted] the whole of the fibre of [redacted] has been extracted. The [redacted] re is washed with water, and dried and bleached by exposure to the sun. A mature plant usually bears about forty leaves from one-and-a-half to three inches broad and from two to five feet long. A ton of these leaves numbering about 22,000, yields from 50 to 65 lbs. of dry fibre. Attempts have been made to extract the fibre by machinery, but upto the present the machines tested have not proved commercially successful. Pineapple fibre is white, very fine and, at the present time, is worth about £30 on the London market. It is employed in the Philippines for the manufacture of the fabrics known as "pina" and "rengue" which are valued at from 1-s. to 3-s. per yard, and are meeting with a growing demand both in Europe and America. The fibre is also used for making small cordage of great strength.

RAMIE

THE TEXTILE OF THE FUTURE

Mr Edwards Radclyffe is the latest apostle of Ramie. He is of opinion that ramie is the textile of the future. Ramie is beautifully lustrous, improves by washing and is many times stronger than jute, cotton, hemp, flax or wool. The *Bombay Gazette* summarises Mr. Radclyffe's opinions in these words;—

"In the past, ramie was condemned on the ground that it would not stand, that it could not be degummed, that it was too hard, that it creased, split, was only fit for ropes, impossible to spin, would not take dye, machinery could not work it. But all these objections have been overcome. Mr. Radclyffe assures us that it does not rot, so that for many purposes, such as fishing lines, nets, sail-cloths, ropes, boots and saddlery thread, tarpaulins, rick-cloths, tents, [illegible]

shop-blinds, boot-linings and other requirements necessitating exposure to damp, it possesses great advantages. It is non-elastic and therein it becomes invaluable for machinery-belting and ropes, and measuring tapes. Mixed with wool, it imports non-shrinking possibilities to that article and many other purposes where rigidity is required. Even yet the list is not exhausted. It makes splendid cloth for uniforms, almost indestructible table-linen, sheeting, dress goods, velvets, curtains, upholstery lamp-wicks, and is ideal for hygienic clothing. It is satisfactory to know that small farmers wishing to start ramie can do so without any great outlay and can prepare the fibre for export without costly machinery. Small parcles of fibre can be shipped."

If half of what Mr. Radiclyffe claims for ramie be true, then it is bound to be the fibre of the future, and enterprising cultivators must keep it before their eye as an excellent substitute for cotton and jute.

Mr. RADCLYFFE'S LETTERS ON RAMIE

I.

To the Editor

Sir,—At last, the merits of this wonderful fibre are becoming known. The Government has at last issued a bulletin recommending its cultivation, though, I doubt, if it will get beyond the pigeon-holes of the bureaux of those to whom it has been sent, and it will still be left to the individual to make it known.

I am pleased to see also our Agricultural and Horticultural and Botanic Societies, Techinical Colleges, and Chambers of Commerce are alive to its merits. Special praise is due to that most up-to-date, painstaking and persevering, though very youn tution, the Liverpool Uni This admirable Institute o mercial Research is maki claims of Ramie, the king o known to our Empire.

It can be grown in mos Colonies. If Ramie were ed in quantity, cotton and flax crises would be banished. It would be universally used if supplies were forthcoming. There is no fear of overstocking the market; the trouble is, those who could and would use it are prevented starting owing to absence of supply. There are fortunes for planters.

There are to be two exhibitions here in London, June and December this year, to advance and exploit Colonial produce. Here is a grand opportunity to exhibit Ramie (Rhea). If any of your

readers have experimental patches of Ramie (Rhea) I would suggest they send samples to me.

1st.—Cut a dozen stems as long as possible with all side shoots, leaves, etc.. etc. Dry thoroughly in the sun before packing. If two long for post, double up, but do not cut in pieces.

2nd.—Strip from other stems about one pound of ribbons—as peeled from the stems, Dry thoroughly in the sun before packing.

3rd.—Strip, say, another pound s, but whilst in a green state, scrape off the pelicle bark, and remove some um. This is easily done ing the ribbons through b and finger, on which is iece of hard wood or or by drawing the ribbons ... edge of a piece of board. Rinse in a little water and thoroughly dry.

If any growers of Ramie will send me these small samples, carriage paid, I will first test and furnish them with a report as to the fibre, gratis. I will also, free of expense to the grower or sender, exhibit his specimens at one of the exhibitions.

I cannot too strongly impress on all who send specimens to be sure all is well dried before packing. I am most anxious to help to introduce Ramie, and I should be glad to know the names and addresses of all who in your Colony are willing to co-operate in introducing the industry. To those who know nothing of Ramie, I shall be pleased to send a pamphlet gratis on the cultivation of Ramie, and I recommend every planter to expeirment—it can be done for a cost of five or six shillings only. In the hope you will help to introduce what may become an enormous industry to your Colony, I will thank you in anticipation. Floreat Ramie!

D. Edwards-Radclyffe,

Staines, England.

The cultivation of Ramie not only means an agricultural industry, but also the possibility of a manufacturing industry following.

II.

To the Editor

Sir,—I have already called your attention to the possibilities of Ramie (Rhea) Cultivation. There is a vast opening for it in our Colonies.

The Royal Horticultural Society, I am pleased to say, is advocating its exploitation. I have the pleasure to give you a copy of the letter :—

Royal Horticultural Society
12 June, 1906.

RAMIE

Dear Sir,

I was glad to see your varied collection of Ramie at our Show. It was extremely interesting, and shows that the plant and its manufacture have great possibilities in the future, if carefully and scientifically conducted experiments are carried out. The Council had much pleasure in awarding you a Silver Medal.

Yours faithfully,
W. Wilks.

The Royal Botanic Society are also recommending and advocating its extended cultivation. They also awarded a Silver Medal and are publishing a report.

One of our leading Agronomists writes :—

"If there is anything in it at all, it means that we have a new industry of no mean importance. It means not only that we may be able to grow and decorticate, but that, later on, like the kindred industry of Jute on the Banks of the Hoogly, we may come to see the degumming, bleaching and weaving of Rhea. Here we have an improvement of the right order, a new Industry which bids fair to eclipse Indigo even in its palmy days. Strength, assuming Rhea to be 100, Hemp 36, Flax 25, Silk 13, Cotton 12, its filaments 2½ to 18, it resists atmospheric influences; air and water have little influence on it, no matter how long exposed; these are only a few of its merits. It is lustrous like silk, an ideal clothing material."

Anyone can grow it. I shall be pleased to send a pamphlet on cultivation to anyone applying. If anyone who has specimens growing will send me samples well dried before packing, I will gladly report on the prospects and quality of fibre. Not only is it an agricultural but later a manufacturing indus our Colonies. All who ha should experiment. It costs to grow a trial patch but outlay for seed.

D. Edward-Ra
Staines, En

SIALINOI FIBRE

It is very little known tha under the above name a very goo fibre is obtainable in Bengal whicl grows in abundance all over the jungles of Orissa and the Centra Provinces. It does not require an cultivation but grows wild all ove the place and it is therefore simpl necessary to collect it and after

short process can be turned into a very servicable fibre which can be used as a good rope making material.

It is a creeper and when fully ripe the thickness of its trunk and branches assumes a very thick size —generally about a foot in diameter, but in extraordinary cases it has been found to have grown so much as 3 feet in diameter.

It does not require any skill on the part of the worker to make rope out of it. When ripe, it is cut down and the trunk is split up into many smaller parts and then to make the same into rope in the ...way.

...e ropes made from it—both ... and thin—have been found ...s strong as those made from ...t the colour is not white, but ...h.

...e cost from the beginning to end is very trifle not exceeding, at the highest, annas ten per maund. The value of the rope in Europe is about £4 to £6 per ton at the lowest or about Rs. 2-8 to Rs. 3-4 per maund which therefore leaves a very fair margin to any one who intends to take it up.

The cost of labour from the cutting down of the creeper in the jungle to the time when it is brought to any of the ports of Europe, is never in all more than Re. 1 per maund as the statement of costs given below will show, *viz.*:—

	Rs.	A.	P.
	Per Maund		
1 labour can cut and bring down 10 maunds of the creeper from the jungle to the place of work in a day at ans. 4 per day, therefore the cost per maund is	0	0	5
Splitting the same into convenient sizes	0	0	6
Making rope	0	1	0
Boat and cart hire to bring to any Railway station	0	1	0
Railway freight from Cuttack to Calcutta	0	5	0
	0	7	11

In all therefore the cost of bringing down Sialinoi fibre in rope form is not more than about, 8 annas per maund, add to it charges for establishment &c., two annas per maund at the highest which will bring it to 10 annas per maund.

Charges for shipping will then be as follows, *viz*:—

	Rs.	A.	P.
	Per Maund		
Baling at (Rs. 2-8 per 5 maunds)	0	8	0
Cart, cooly and boat-hire to bring it to the side of the steamer	0	3	0
Steamer-freight	0	10	0
	1	5	0

Thus we find that the cost of landing the fibre in the ready made form of rope of any size will be at Re. 1-5 or say Re. 1-8 at the highest per maund or about Rs. 41 per ton which in English money will be about £2-14-0 per ton. Thus, taking the lowest value to be

realised in England to be £4 per ton, there will be a very good margin of about £1-6-0 per ton or about 13 annas per maund which is not very much discouraging.

A NEW FIBRE FROM LADY'S FINGER

"M. S. P." writes to the "Mysore Herald: "You know a vegetable called "Lady's finger" otherwise known as *"Bendekayi"* in Kannada. The plant is reared in all vegetable gardens. The fruit is used in our kitchens for curry etc. In the course of an investigation, I found that this plant resembeled what is generally called Senabu or Pandi in the Mysore country. You know Senabu is cultivated merely for the sake of the fibre it yields. The resemblance between *Senabu* or *Pundi* and the *Bendekayi* plant was very striking. The stem, the leaves, the flowers in their different sub-divisions were also so exactly similar, that I was forced to conclude that the *Bendekayi* plant must belong to the same species and must yield the same kind of fibre as *Senabu* or *Pundi*. I tried the experiment and found the result to be very satisfactory. I got the stem soaked in water for 8 or 10 days, and after removing the external skin, I succeeded in getting a beautiful fibre. It is long, white, glossy, strong, smooth and fine. If it can be made softer than it is, I believe very good cloth can be made out of it. Not being a professional man, I do not know what should be done to make it as soft as cotton.

There is a fibre called *Bende* fibre in the field. I asked for the opinion of a forest officer who assured me that there was a big tree called the Bende tree, that the fibre extracted from it was thick and rough, and that it had nothing to do with the *Bendekai* plant fibre, which was entirely new. some specimen of the new the Mysore Exhibition. If already in the field, I am afr letter of mine may be constr blowing my own trumpet; pray that it may be indulgen tributed to my want of p knowledge on the subject. But if on the other hand, it be found to be a new fibre, I may be allowed to submit that, the cultivation of this plant is pregnant with double advantage, firstly, it yields fruits which are largely sold in the market as an article of ordinary daily consumption, and secondly, it yields a good fibre fit for different purposes."

An actual experiment was made with a few stalks cut out of one of these vegetable plants which are to

be found in almost every kitchen garden. They were kept steeped in water for about a week and beautiful white fibre was got out of them which can scarcely be distinguished from the best specimen of jute fibre ordinarily sold in the market.

MALVA

A new plant, called "*malva,*" that produces first-rate fibre, has been discovered in the Mexican State of Sinaloa. Its cultivation s little or no labour.

RJEELING NETTLE R NILGIRI NETTLE

The "Journal of Horticulture" writes:—"An interesting item in a report on economic investigations with regard to Indian products conducted recently at the Imperial Institute in London concerns a fibre of *Girardiuia heterophylla,* which was sent from Calcutta for examination and report. The result of the investigation showed that this fibre possesses valuable properties, and is remarkable especially for its ability to withstand the action of alkali, its richness in cellulose, and the length of its ultimate fibre (6 in to 20 in). The verdict on the examination of the Calcutta sample is that it is highly probable that if this product could be prepared on a commercial scale, it might take a high position among textile fibres." The plant is known as the "Nilgiri Nettle" and "Darjeeling Nettle." The fibre is used in the local manufacture of a cloth that takes the place of woollen materials with the natives.

AKAND FIBRE

The *Akand* plant yields soft and light fibres. It grows wild in abundance all over the country. Its cultivation on a systematic scale, coupled with the latest scientific process of extracting the fibre, is found to be a paying industry. The plant does not require a good soil and huge tracts can be had on nominal rent.

ARAMINA FIBRE

The recent announcement that experiments conducted in the Sibpur Botanic Gardens with the Aramina Fibre of Brazil have shown that the plant is of no special value as a commercial fibre

producer will cause much disappointment to those who expected even greater results from the cultivation of Aramina, than Mr. Edwards Radclyffe, the ramie enthusiast, looks for from his favourite textile. It is stated that the Sibpur people have identified the plant as a common tropical herb (*Triumfetta rhomboidea*). This latter plant, it may be mentioned, is fairly common in many parts of India. In the South, it goes by the name of *chikty*. There are several species, the one grown in Sibpur being a yellow-flowered variety, which is used as a pot herb in times of scarcity. It possesses a coarse, strong bark, but the natives have evidently not considered this bark as possessed of any textile value. The plant, it may be added, is allied to the West Indian burweed. Both the Indian and West Indian species are particularly recognised for the mucilaginous leaves and fruits, which are medicinally employed in Brazil. There are, however, certain Brazilian varieties of the same order, the fibres of whose inner bark are very tough and are used for a variety of economical purposes Could it be then, that the plants experimented with at Sibpur are not identical with the species which yields the highly spoken of Aramina fibre of Brazil? When this fibre was first brought to the notice of the Imperial Institute authorities a few years ago, it was thought probable that the substance might compete with jute for certain classes of goods. Dr. Sylva Tolles of the Sao Paulo Polytechnic School, expressed his opinion at one time that the fibre was probably derived from '*Uoeno Lobata*' and was likely to be of great value for cloth weaving, spinning and other purposes, being more silky and stronger than jute and comparable with the best kinds of hemp. In Brazil, the plant is easily grown. On chemical examination, the fibre was found to contain a high percent[illegible] cellulose, the results being similar to those obtained [illegible] jute of the best quality. [illegible] ous experiments, subsequent[illegible] ducted, demonstrated the ex[illegible] qualities of the fibre, fine s[illegible] of rope and other woven materials having been manufactured from it. Indeed, an Aramina exhibition was held a few years back in the City of Sao Paulo. The plant, it it is understood, is now extensively cultivated on a systematic scale in Brazil, and there is a factory at Sao Paulo exclusively for the manufacture of goods from Aramina fibre. London fibre brokers have estimated the value of the raw fibre approxemately at £17 to £18 per ton.

Assuming that the Brazilian fibre is the product of '*Urena*

Lobata,' it is all the more probable that they have not got hold of the right plant at Sibpur, for 'the *Urena* belongs to a different order from that in which "*Triumfetta rhomboida*" is found. The former belongs to the *Malvaceoe*-order, the latter comes under *Tiliaceoe* which is closely allied order, containing, according to the older botanists, about 250 species arranged in 32 genera. The Trincomalle wood used in Madras for making Masula boats is, I believe, form one of the species of this order. Now, '*Urena Libata*' is by no means un- ı in India. It is a herb which ds in strong fibres, that have been treated as a substitute x. The natives call the plant, cotton, and in some parts country, one of its titles is t *caltropis*. It has roundish ves, with three or more short obtuse lobes and rose-coloured flowers. In Southern India, the the flowering season is from August to October and the plant is fairly common in waste places during the rains. This plant, and also another variety, *U. Sinuata*, were long ago specially mentioned as used for the manufacture of cordage in India. The Hindustani name is, "*jungali kapas*," or wild cotton. Assuming then that the plant which yields the Aramina fibre of Brazil is identical with our own '*Urena Lobata*,' it may be suggested that the Indian species should be got hold of and a further series of experiments set on foot at Sibpur. It may be mentioned that there are several instances where much fuss has been made in this country over imported plants, which our own indigenous varieties of those same plants are undeservedly neglected by our botanical experts and experimentallsts—C. in "Capital."

FLAX

THE LINSEED PLANT—A NEGLECTED INDUSTRY

In India, flax is quite an unknown article and we have seen many people consider Hemp and Flax to be the same thing, and Flax to be but a synonym for Hemp. It is therefore a matter greatly to be regretted that, notwithstanding the existence of ample facility and when the plants may be very easily and in abundance obtainable, the industry has so long been totally neglected to the great loss of the country.

Flax is made out of Linseed plant and as Linseed is every day being grown in larger and larger quantities throughout India, the stalks of the plants, out of which

this most important fibre is made, are also more largely obtainable. But it appears that the people, not being aware of the value of the stalks and not even ever dreaming that any better use can be made out of them, use these stalks, after Linseed has been gathered, as fuel. Thus, every year, millions of rupees are being regularly consigned to fire, when this large amount of money could easily have found food and clothing for millions of the poor starving Indians. But, on account of their complete ignorance of the properties of the articles, except a few which they cultivate themselves or which are cultivated by their neighbours, they fail to utilise them to their benefit.

Flax is a most valuable fibre and fetches such a high value as £60 per ton, when the quality is superfine. The lowest value at which Flax has ever been sold, when the quality is very inferior, is £23 per ton. £60 per ton in Europe —means in India, after deduction of freight, commission, packing &c. &c., at the lowest £55 per ton. Taking Rs. 15 to be the average value, in Indian money, of one pound sterling, the value of 1 ton Flax at the above mentioned rate (£55) comes to be Rs. 825 or about Rs. 30 per maund. This of course is the value, for extra-superior quality, but the lowest quality, which fetches £23 per ton in Europe is equivalent, in Indian money, after deduction of all the above charges, to about Rs. 12 to 13 per maund. As the expenses of cultivation, including ground rent, labour, manures &c. &c., are amply recovered from the sale of Linseed or the seeds of the Flax plant, the amount that may be obtained from Flax, whatever may it be, is an unmixed and nett profit to the cultivator. Even if Linseed were totally unsellable, the Flax of fibre alone would be sufficiently valuable return for the money spent in the cultivation of the plant and leave a margin of profit which now s of like a fairly tale. What an a wealth is thus being every lost to us, simply through ign of the economic value of the around us.

The Flax or rather the Li plant is known nearly to one who has any knowledge of the muffissil. Linseed has become widely known as one of the articles most extensively shipped as an important oil-yielding seed plant. seed plant it must not be cut at all above the root but must be drawn out of the ground with roots. In Egypt they used to immerse the plants in water already heated by the sun and put some weights over them to keep them under water, as the stalks of flax are very light and otherwise would float on the water. After a few days when the

brance of the rind was found loose, the Egyptians used to take the stalks out of the water and spread them in the sun to dry. After a day or two, when they were perfectly dried, they used to beat the already dried stalks by mallets on big stone slabs or on some other hard substances and the fibre was separated. They the used to assort it into two parts—one that is nearest to the skin and the other that was inside. The one nearer the skin was inferior to the other, which was much whiter and used to fetch much higher price.

e above is the oldest known d adopted by the Egyptians hundred years ago. But ıe spread of civilization, other methods are in use to ex- this valuable fibre out ot the If the plant is to be culti- only for the sake of the fibre, the crop ought to be pulled before the capsules are quite ripe and just when the colour was getting to be pale brown from rich green and about two thirds of the plant itself have become yellow in color Then the various methods that are adopted to extract the fibre from the flax plant may be classified under four principal heads, as follows viz:—(1) pulling, (2) rippling, (3) retting and (4) scutching.

Pulling—As we have said above, pulling is the first most important operation towards extracting the fibre out of the plant and it means taking the plants out of the ground by the roots carefully and on no account scythe or knife is to be applied to the plants. The pulling out ought to be done in clear and dry weather and rainy and fouz weather must be avoided as injurious to the fibre, as will be explained hereafter. After the stalks have been properly pulled out by the roots, they are to be arranged according to their lengths and all the root-ends placed even and the stalks parallel. These little precautions, though in the beginning seem to be quite useless, are really very important to make the quality and appearance of the finished stuff better. Immediately after the pulling out process, what one has to do what is known as—

Rippling.—This operation is generally performed in the field immediately after the pulling. The best apparatus for rippling or removing the "balls" or capsules, consists of a kind of comb set in a wooden frame, iron-teeth of which are made of round-rod iron, three-sixteenth of an inch asunder, at the bottom and half an inch at the top and 18 inches long, to allow a sufficient spring and save much of the breaking of flax. The points should begin to taper 3 inches from the top. This machine is placed in the field and two men sitting opposite each

other pass the stalks with gentle force, so as not to break the fibre through the teeth and thus both seeds and fibres are separated. The fibre is afterwards properly washed in clean water to cleanse it of all the dirts, gums and skins. This method is neither the best nor is it generally adopted. We give below the method that is more generally adopted and which is known as *retting* or *water-retting*.

Retting or water-retting.—In this process, the stalks are made into small bundles, which are properly tied with a string. Then these bundles are packed in a dam, roots downwards and when fully packed, over the top of the layer is placed a stratum of rushes and straw, or sods with grassy side downward and above all stones of sufficient weight to keep the flax submerged. The dam need not be more than 4 feet deep 50 feet long by 9 feet broad. Such a dam is sufficient to ret the produce of an acre of flax. The dam is to be filled only with clear soft water free from iron and other minerals. Any water much impregnated with lime is also to be avoided. Water, mixed with iron or other metals, may impart peculiar colour to the hemp which is not only commercially objectionable but may also materially weaken the fibre itself. After a few days of thus putting the stalks in the dam, the action of heat of the sun makes the water warm and a sort of fermentation sets in and gaseous bubles appear on the surface. In a few days, the fermentation subsides and generally, in from 10 to 15 days, the process ought to be complete, if the weather continues dry and fine. As the steeping is a very critical operation, the stalks are to be frequently examined and tested as the process nears the completion. For, as in one respect, too long immersion in water, may materially weaken the fibre, on the other, if the period is too short, the fibre may not be easily extracted. [illegible] on examination it is found th[illegible] fibre separates easily and [illegible] from the woody "shive" or [illegible] the beets or small bundle[illegible] ready for removing from the [illegible] Stalks are then evenly, equall[illegible] thinly spread over a [illegible] meadow where they are left [illegible] dried for about 15 days, after which the fibre will have partly separated from the core. It is now ready for *scutching*, but in order to get a better fibre, it is advisable to keep the dried stalks in stock for some time before they are taken to the *scutching* mill.

The Russian and Archangel flax is, however, made in a completely different way, where steeping in water is wholly done away with. This method may be termed *dew-retting*. Under this method

the stalks, after they have been pulled out as stated above, are spread on the grass where it is under the influence of air, sunlight, night dews and rain. The process is very tedious and the resulting fibre is brown in colour and it is said to be peculiarly liable to undergo heating, if exposed to moisture and kept close packed with little access of air. But this flax is however peculiarly soft and silky in appearance, though by water-retting as described above, an equally good or better fibre may be obtained.

term Flax (German *Flachs*, *Lin*, Latin *Linum*) is em- both for the fibre and ant is botanically known *um Usitatissimum* and be- o the natural order *Linaceæ*. plant has several varieties have been under cultivation probably since the dawn of civilization and therefore its wild or parent state is quite unknown.

Flax is the oldest fibre known in the world and the people used to make nets, fishing lines, ropes etc., and, in short, its use was so very extensive embracing all stages of the existence of the ancient people, that they thought that they could not live without it. It was most extensively cultivated in Egypt and in almost all the countries of Europe, but, at present, it is very little cultivated in England, though the Government tried its best to keep it up.

There are several methods of preparing the fibre out of the plant and we shall gradually describe them here, one by one. The first and the most important part of it is that unlike any other, these methods were not only very primitive, but used to occupy long time and could not be carried on indoor and consequently were very tedious. Besides the above defects, as the heat of the Sun was the principal agent in helping the process of retting, the workers had to depend greatly upon the mercy of the weather. With a view therefore to obtain the fibre much quicker and without the natural help of the Sun or weather, several methods were invented of which the following are the most important and worthy to be recorded.

Attempts towards achieving these objects were made in the early part of the 19th Century, when one Mr. James Lee proposed to obtain the fibre from the Linseed plants by purely mechanical means, completely doing away with retting. His method was given a very fair and expensive trial, specially by the Irish Linen Board, which expended many thousand pounds to erect the necessary machinery of Mr. Lee, which was, however, found to be a complete failure and was abandoned for

over. Next in the field was one Mr. Chevalier Claussen. This gentleman, in 1851 or thereabout, wanted, with the help of chemicals, to make cotton, out of flax. But his invention too was a failure, in as much as the stuff, the cottonised flax, which he prepared with the chemicals and which indeed looked like cotton, was found to be of very much inferior to the latter in its usefulness. Hence his invention of making bad cotton out of good flax was also abandoned as of very little use for commercial purposes.

The only practical improvement in the separation of the fibre from the stalks and which has been since adopted largely, was inveted by one Mr. Robert B. Schenck, an Amarican, and patented in England in about the year 1848. His method is very simple and consists of admitting into the vat or dam, water artificially heated to a temperature of 75° to 95° Fahr., and steeping the plants in this water and keeping up its heat the whole time, generally 50 to 60 hours, the flax was in the steep. Within this time, the flax was ready for scutching. This invention was a great help to the makers of the fibre, as, it not only reduced the time to the lowest possible limit, but enabled them to work under sheds.

A further improvement on the above described method was effected by another invention patented in England, by one Mr. Pownall, which consisted of passing the stalks, immediately after they were taken out of the vat of warm water, between heavy rollers over which a stream of pure water was kept flowing. This invention not only helped the glutinous adherent matter to be thoroughly separated but the subsequent process of breaking and scutching were also much facilitated. The next and the last process is called *scutching* which is separating the fibre from the stalks and finally mak ready for the market. Thi used to be done in ancien by hand, but now several va of scutching mills have been duced to effect economy.

Almost all the countr Europe grow flax; but, it a that the production is precepitately decreasing every year. The reason of this decrease is not however attributable to any want of profit in its cultivation but to the fact of its being confined as a sort of domestic industry. In all the countries, the peasants cultivate comparatively small plots of land for flax originally intended for their own use and all the different processes from the tilling of the ground to the rippling, retting and scutching, are all done by themselves in the primitive way without any outside help. Thus the busi-

ness is solely confined to the peasants, who give it up, if they get a more lucrative employment. On account of the absence of a regular and systematic trade in this article on any large scale with proper capital, the trade is gradually dying out. Over and above this, the introduction of cotton on a larger scale, and the establishment of large mills and manufactories of cotton goods all over the continent of Europe, flax industry is being given up for cotton. In Great Britain and specially, this industry is given up by the peasants employ themselves, for remuneration and certain in jute and cotton mills, standing the most liberal offered by the Govern- o keep up the industry. incipal reason for giving up the cultivation of flax is that the peasants who are generally poor, more readily employ themselves where they are sure of earning their wages than in any uncertain work, though more profitable if successful, for which they have to depend upon the fickleness of Nature. Thus we find that the production of flax is decreasing every year in Europe and it is therefore that there is a great opening for India to grow it to her great profit.

Of all the countries Russia even now produces by far the largest quantity of flax available for export. Germany comes next and Great Britain, considering its size and population, is the last. But in quality, the flax grown in Belgium occupies the highest position.

Belgium flax is however prepared in a quite different way. After having dried the flax plants, the Belgians store them during the whole winter following the crop. In the spring of the following year, the stalks are retted in crates and then they sink the same in the river Lys, which flows through the flax growing area, and is practically currentless. After a a certain time the crates are withdrawn and the sheaves taken out and stocked. Then the stalks are tried up again, placed in the crates and sunk in the river to complete retting. When finally taken out, the stalks are unloosed and put up in cones instead of being grassed and when perfectly dry, they are stored for some time previous to scutching. All these operations are gone through with great care. This fact, coupled with the peculiarly favourable soil, climate and water, makes the flax very superior in quality to any other in the market.

The cost of production in India, where the rent is not excessive and the cost of manures, labour &c.. is comparatively much

cheaper than in the European countries, must necessarily also be very much cheaper than elsewhere. It is therefore expected, provided the quality is equal to that of Europe, that the magin of profit here ought to be much larger. The estimate given below will certainly differ in different countries, but that difference is so very insignificant as not to materially alter the expected profit. We give below an estimate of the costs of production which we believe to be not far out of the mark.

	Rs.	A.	P.
Ground rent per acre (about 3½ bighas) at Rs. 4 per bigha...	13	0	0
Labour for ploughing an acre at the rate of 4 men per bigha = 13 heads at 4 ans. per head	3	4	0
Levelling and weeding at the rate of 2 men per bigha or 7 men at 4 ans. per head ...	1	12	0
Planting at the rate of 4 men per bigha, 13 heads at 4 ans. per head...	3	4	0
Harvesting at the rate of 4 men per bigha, 13 men at 4 ans. per head...	3	4	0
Value of seeds	1	0	0
Ordinary manure	10	0	0
Total Rs.	35	8	0

Each acre of land yields stalks with seeds weighing in all about 100 maunds at the lowest. Taking the outturn of Linseed to be 12 per cent. at an average, Linseed alone will weight 12 maunds, value of which at an average of Rs. 4 per maund will be Rs. 48, thus leaving about Rs. 12-8 per acre as profit in the seeds alone.

Then, from experiments made in Europe it has been found that, the yield of finished fibre is about 8 to 9 per cent. on an average of the dried and bolled straw. In an acre, therefore, after gathering the seeds there will be left about 85 to 90 maunds of dried straw, as we have said above, and therefore the weight of the finished fibre will be about 6 to 6½ maunds. Taking the lowest value that the fil fetch in Europe to be £30 on an average, the value fibre per acre (6 mds.) will l Rs. 100 or about Rs. 16-8 From this amount of cou have to be deducted the manufacture, and the oth such as Ry. freight, Retting &c, commission, shipping &c. which may be taken as under, viz., —

	Rs.	A.	P.
Retting, 80 mds. of straw will require 8 men at the highest, at 0-4-0 per head	2	0	0
Coolies to carry the same into the vats at 0-0-6 per md. ...	2	8	0
Taking the same out of the vats and drying	2	8	0
Breaking and extracting fibre at the rate of 0-1-0 per md.	5	0	0
Total, Rs.	12	0	0

	Rs.	A.	P.
The cost of bringing the same to Calcutta 6 mds. at 0-12-0 per md. at the highest ...	4	8	0
Baling at 2-8 per bale of 400 lbs....	3	0	0
Shipping charges	0	8	0
Freight to Europe for 6 maunds at £1 per ton	3	8	0
Commission at 2½ per cent.	2	8	0
Landing and other charges in Europe...	1	0	0
Total, Rs.	15	0	0
Or all the expenses put together will be at the highest, Rs. 27 for every 6 mds. or the yield per acre.			
Value of Linseed	48	0	0
Value of fibre	100	0	0
Total, Rs.	148	0	0
Less the cost of production, ture and other charges 7)...	62	8	0
Balance profit Rs.	85	8	0

s we find that in an invest- about Rs. 62-8, there is the of making, at the lowest, or about 140 per cent. of the outlay. There is every of making a much larger profit as we have calculated the values of both Linseed and flax at the lowest and the cost of production and other incidental charges at the highest possible figures.

In our opinion therefore this trade may be taken up by every one and specially by those who have no large capital to invest in any other existing business and consequently hanker after service and are willing to sell their body and soul to their masters for trifling sums.

—Market Report.

THE *BALKALBRIKHSA*

OF THE BARK TREE

Mr. Isvar Chandra Guha of Jamalpur, Mymensingh, writes to the 'Amrita Bazar Patrika,' Calcutta:—

It is well known to every Indian, that Sri Ram Chandrá, the hero of the Ramayan, was an exile in the Dandakaranya, with his devoted wife Sita and beloved brother Lakhshana, for a period of fourteen years. During this period he, his brother and wife had to wear the bark of trees (*Balkal*) to cover their bodies. We find in our Puranas that Yogis and Rishis were also in the habit of using bark of trees as their wearing apparel. One may wonder how a man can wear barks of trees. In reply, I would say that the simple people of these days were not fond of luxury as those of the present day. In those days every man, either poor or rich, Raja or Maharajadhiraj, while they lived a decent life, did not knew what luxury was. Not that cotton and silk cloths were unknown them, but they preferred barks of trees to those made of the former stuff. These were obtained from a genus of Ficus trees, which were then most common in the mountains and in the hills of India.

Now, very few people of our country, however, know what that tree was like. I find on enquiry that the same species of trees, which used to yield bark-cloths to the people in good old days, still exist, but they are now not known to us.

Sometime ago, I brought a variety of Ficus tree from the hills. It is commonly called by the hill people as *Bakalgachh*. The bark of this tree is up to this time used by them for their wearing clothes and beddings. The bark is quite fit for the above purposes and is very warm. During the chilly cold days of the winter, a piece of the bark-cloth is sufficint to keep a man warm and protect him from intense cold. It bears a peculiar sort of odour for sometime, after it is extracted from the tree. It may also be used as mat or "*Sataranchi*," A full-grown-plant will yield a bark measuring about 25 feet by 10 feet or more. These trees grow in the Khasia, Jaintia and the Garo Hills.

A piece of cloth of this interesting plant was sent by me to the Superintendent of the Royal Botanic Gardens, Calcutta, for examination. It was forwarded by the latter to the Reporter on Economic Products to the Government of India, for ascertaining, if it had any economical value. I quote below the remarks of these two officers for the information of your readert. The botanical name of this plant has not yet been ascertained, as materials for its precise identification are still incomplete.

Here is the better of the Superintendent, Royal Botanic Gardens, to me.

"In returning the following specimens received with your letter of the 4th instant, I have the honour to remark as follows :— * * * As regards numbers 3 and 5 (bark-cloth and p[illegible] leaves of the bark tree), I inform you that these have transferred with your let original to the Reporter on nomic Products to the G ment of India, who will pr address you direct, if the pl its products is of econom portance."

The follywing letter was addressed to me by the Reporter on Economic Products to the Government of India, Mr. J. Henry Buckel :—

"Your specimens of cloth from the bark of Ficus have been sent to me by the Superintendent of the Royal Botanical Gardens, Calcutta. They are interesting. Ficus barks have long been used for cordage in India and for paper-making.

"I return your bark as requested but I should be extremely obliged if you would obtain for me a sample of the cloth and a small branch with leaves and fruits for the purpose of precise identification."

I am trying to find out if cloth could be made from the fibres of the bark of this tree, after extracting them by mechanical processes. With this object in view, I have sent specimens of bark-cloths to expets and Superintending Officers of the several Schools of Arts and Industries in India. I shall publish the results of my enquires in due

The bark itself is very
without any change in its
re, as it serves the purpose of
g and *Patonchi*. It is last-
t the same time not very

rupees. The business, therefore, is sure to yield profit and it is highly desirable that in these days of indigenous industrial revival, our countrymen will not lag behind in starting plantain tree fibre concern at an early date. Plantain fibre extracting machine has been invented at Travancore, and experiments made with it at Pusa have proved that it is serviceable. Again, the Muga fibre extracting machine has also been utilized in extracting fibres from the plantain tree. Information about the former machine can be obtained from the officer-in-charge of the Government Agricultural Farm at Pusa and that about the latter machine can be had of the "Eastern Landing, Clearing and Forwarding Company" in Calcutta.

THE PLANTAIN FIBRE

GENERAL NOTES

Plantain-tree fibre is said to be in demand in England. A ton of such fibres fetches an amount varying from £25 to £35 in the London Market. And the cost for extracting a ton of fibre together with the charges for their transmission to England comes to one hundred

TRIVANDRUM SCHOOL OF ARTS ON PLANTAIN FIBRES

Those interested in plantain fibre, should address the Superintendent of the School of Arts, Trivandrum, Travancore, South India, where a plantain fibre machine is made at a cost of

Rs. 10. It is described as follows:— The frame-work of the machine is of teak wood, and the scraping fluted rollers fitted parallel to each other at the top, are actuated by two separate strong steel springs worked by foot levers. The machine, on the whole, is sufficiently small and light to enable it to be carried conveniently to the very spot in the plantain gardens, where the trees are cut, thereby saving a large expenditure that has otherwise to be invariably incurred in the transport of the raw material. The additional mechanism for squeezing with the fluted rollers which work in advance of the scraping operation gives greater pliability to the plantain sheaths and renders the extraction of the fibre much easier. The fibre thus obtained can consequently retain the full length of the seaths available, little or no breakage occurring in the process of extracting.

THE SUPERINTENDENT'S LETTER.

The Superintendent writes in answer to an enquiry:—

" * * * there is no book or pamphlet on the subject of the plantain fibre industry. * * * If your brother is in earnest about seeing what little we have been able to do in the development of the fibre industry, he is by all means welcome. I have no doubt he will be able to pick up all we do, in the course of a month".

MR. PILLAI ON THE FIBRE.

Mr. T. Ponnombalam Pillai, whose contributions on economic subjects and archæology have been highly spoken of contribut following most interesting c nication to the "Madras on the subject of the planta industry;—

" In one of the recent i the "Madras Mail." my frie M. S. Thiruvariyan Pill Nagercoi, did me the hon mentioning my name in connection with the plantain fibre industry in Travancore. Since the appearance of his letter, I have been flooded with letters of enquiry from different parts of the country, including Northern India. I, therefore seek the medium of the columns of your widely-circulated journal to place at the disposal of the public *all the information in my possession* on the subject.

"I must at the outset correct one or two errors into which Mr. Thiruvariyan Pillai and [illegible]

correspondents have innocently fallen. I have not published a special brochure on the subject, but I have made a short reference to it in my lecture on "The Mine of Wealth in the Forests of Travancore and What Young Travancore could do to Create Industries." This was delivered under the auspices of the Travancore Government Lecture Committee in April, 1902. The lecture has been published under the orders of Government, and copies of it are available from the Honorary Secre-

Ir. M. La Bouchardiere, M.A.
Mr. Thiruvariyan Pillai is
iite accurate in stating that
dustry has been successfully
Travancore by Mr. Ponam-
Pillai." I was of course
iental in introducing the art
racting the fibre into the
te, for, at my suggestion, the
vernment of H. H. the Maha-
h were pleased to depute three
men to Ootacamund to Mr. Proudlock, who is the pioneer of this industry in Southern India. At the instance of a mutual friend, Mr. M. La Bouchardiere, Professor of English in the Maharajah's College and a botanist of no mean order, Mr. Proudlock undertook to teach my men the art, kept them with him for about a month, put them in the way and sent them back with five machines, for which I paid only [illegible]

"When these simple appliances were placed before Dewan Bahadur Krishnaswami Row, the then Dewan, and the mode of extracting fibre was demonstrated in his presence, he was so charmed with what he saw that he declared that a great industry was looming in the future for Travancore, and set to work at once to give it a start. He called upon Mr. Naiayant Aiyar, B.A., the talented Superintendent of the Travancore School of Arts, to make experiments of manufacturing fabrics out of this fibre. With that inventive genius characteristic of him, Mr. Narayana Aiyar took up the matter earnestly; extracted fibre from no less than twenty nine species of plantains, tried to improve its gloss, durability and pliability by washing it with alkali, soda, and soap and by tanning and dyeing it that it might excel silk and cotton in all their essential qualities. He also found out that it was ready for the loom soon after it was extracted and that it required no spinning. He invented the requisite machines for bobbin-winding. He had, further, to improve the ordinary loom, as it was found not to work well. But, unfortunately, the result was not as one would wish, for the warp thread was found to break, in spite of all possible care. Mr. Narayan aiyar had, therefore, to

content himself with the weft thread alone from plantain, making use of cotton for the other. Notwithstanding his drawback, the cloths woven in this manner looked like silk and proved to be light and less costly than fabrics made of cotton, and one of them secured a prize at the Exhibition held at Ahmedabad in December, 1902.

" From the experiments made, Mr. Narayan Aiyar found out that an ounce of fibre was enough to cover an area for which 3 oz. of cotton were necessary; consequently the cost must be proportionately reduced. In addition to fabrics of delicate texture, lace and embroidery works, coarse cloths, carpets and curtains could also be made of this stuff. Trials after trials are still being made, so that the time is not distant, when success is certain to be attained in manufacturing cloths and other articles entirely of plantain fibre without the admixture of cotton, under the fostering care of Mr. V. P. Madava Row, the present Dewan of Travancore, who takes a keen interest in the technical education of the people and who is ever ready to encourage all local and indigenous industries and thus improve the material wealth of the country. When these experiments are crowned with success, I feel no doubt that there will be a great demand for this cheap fabric of all kinds, and I do not in the least share the pessimistic view of Mr. Narayan Aiyar. But till such time, the enormous quantity of raw material that is thrown away at present throughout India should be utilised in other directions.

"In my paper on the Travancore forest, I have referred to the uses of this fibre, and prominently amongst them to the manufacture of paper and cordage. The whole of Europe and America are paper-producing countries and there are lots of mills in India for the same purpose. If fibre could be supplied at that would bring in a profi the vendor and vendee, certain that it would be c in large quantities. I h some time been in corresp with European and native the Malabar coast, and I am ced that to ensure success in the trade, and to create an attractive market, the supply must be perennial, and the persons dealing in fibre should be able to collect n less than fifty tons a year. But t quotations of the firms above r ferred to have not been very tem ting, inasmuch as, they ranged fro Rs. 200 to Rs. 400 per ton. I thin however that the prices must with the demand, which shoul created by a never failing

"Mr. Narayan Aiyar owing to the extension

that is being done in cocoanut coir in Travancore and Cochin there may not be a great demand for cordage made of plantain fibre. It is an undoubted fact that the Manilla hemp plays an important part in ship-building. In case it is proved that hemp is inferior or equal to plantain (as he has tried to do), the plantain fibre procurable in the country could be exported for that purpose. I have reason to believe that owing to the lack of it in large quantities in the Philippine Islands, other fibres are used to adulterate it or to pass off

One kind of such fibre is hich is extracted from the of aloes called Adam's (*Yucca*). This is largely to in the southern and eastern Travancore and the Tin- District and is exported to . From a cursory examina- of the fibre of the *Yucca* and of the plantain, it will certain- observed that the latter is rior in point of gloss and strength, and the length of each individual thread is five or six times that of the other. It can therefore safely supplant the fibre of aloes of all kinds, including the broad leaved Agave-American, and create an honest market for its cordage."

"Now to the machine. The mechanism of the one supplied to simple. It consists of a smooth piece of wood $4'' \times 6'' \times 6''$ on two posts attached to the ground and a blunt knife fixed to it lengthwise with its edge downwards. One end of a string is attached to the handle of the knife, and the other to a long piece of bamboo to form a lever which is pressed by the left foot while the workman stands facing the machine. But this machine is devoid of one important facility, viz., portableness. As pointed out by Mr. Venkatarama Aiyar, of Valavanore, South Arcot, the machine should be so handy as to be carried by a cooly from garden to garden along with one full load of fibre, for the object of the fibre collector should be to carry with him only the marketable commodity, instead of encumbering himself with the heavy plantain stems, to a central place.

"The mode of extracting this fibre is as follows. Long pieces of plantain sheaths or leaf stalks less than 2 ins. in breadth are inserted between the blunt knife and the smooth piece of wood referred to above, and then pulled with some dexterity, while the pressure put on the lever by the left foot assists in raising and dropping the blunt knife. This process should be repeated till the succulent matter is got rid of and pure fibre is severed from it. Till some skill is

the whole of the fibre may not be obtained. But constant practice will enable one to secure every bit of it. In some improved machines, cylinders have been introduced to crush out the cellulose substance as a preliminary step. When this process is gone through, the sheaths become more pliable. Mr. Proudlock thinks that the fibre could be extracted by scraping the sheaths with two sharp pieces of bamboo, which primitive method is the one that is in vogue at present in the Philippine Islands. I have successfully extracted the fibre by scraping the sheaths with ordinary cocoanut shells. Place a sheath on a smooth piece of wood or plank, hold tight one end of it by pressing your left foot on it, and scrape it between that foot and the other end, by the sharp edge of a cocoanut shell. When you have removed all the succulent matter, reverse the sheath and repeat the process. Of course, some skill is necessary in extracting the fibre in this manner, but it can be gained only by experience.

"The following is an account of an improved machine made at the School of Arts, Trevandrum, as described by its Superintendent:—

"The frame work of the machine is in teak wood, and the scraping blade with the squeezing fluted rollers fitted parallel to each other on the top, are actuated by two separate strong steel springs worked by foot levers. The machine on the whole, is sufficiently small and light to enable it to be carried conveniently to the very spot in the plantain gardens where the trees are cut saving thereby, a large expenditure comparatively that has otherwise to be invariably incurred in the transport of the raw material. The additional machanism for squeezing, with the fluted rollers, which work in advance of the scraping operation, gives greater pliability to the plantain sheaths and renders the extraction of the fibre much
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longing to one Mr. K. G. G
at Paravur, close to Quilon,
a small portable machine

the fibre of pine-apple (*Bromelia Ananas*), and at my request, he tried plantain sheaths and found it possible to extract its fibre. It is built on the same principle as the one described above, but its cost is only Rs. 3. Mr. Govindan is now engaged in perfecting it and rendering it less costly. In this connection, I would ask your readers to peruse the pamphlet published by Mr. V. T. Venkatarama Aiyar, of Valavanore, South Arcot, on "Plantain Fibre Industry," sold by Messrs. Srinivasa, Bardachari and Co., Madras, at ...as per copy, as it gives a ...deal of valuable information ...ting it."

...e following is the conclusion ... T. Ponnambalam Pillay's

... paper like this will be incomplete without a short account of the leading species of plantains that are found in Travancore and the mode of cultivating some of them. Mr. Venkatarama Aiyar speaks only of a dozen varieties of '*Musa Sapientum*' found in the District to which he belongs. It is likely that a few more will be found in the delta of the Cauvery. The Superintendent of the School of Arts, Trevandrum, has tested twenty-nine kinds, and he did not go in for others, as he thought that the plantain fibre of all species possessed almost the same identical virtue. I have come across about forty-five varieties, and all of them yield fibre of economic value. There are others which I have not tested, but I hope to study them at leisure.

"The most important of the species found in Travancore and Cochin is the banana, which goes by the name of "*Nantram*" or "*Etta Vazah*"—I think botanically it is "*Musa paradiastca.*" Mr. Venkatarama Aiyar speaks of it, but it is seldom to be found on the eastern coast of Southern India. Unlike other species, it has to be raised annually, and it is thus cultivated extensively in the two sister Native States. With regard to other species, excepting those that are raised on paddy fields, if they are planted, once the family will continue to flourish for ten or fifteen years, provided the soil about them is turned and the groups heavily manured, once a year. But in the case of banana, fresh seeds have to be put in every year at the proper season and the following is the mode of its cultivation. When the bunch is cut off from the parent plantain, its shoots are removed and their stems thrown away, leaving the yams at the disposal of the cultivator. These are dipped in a strong solution of fresh cow-dung,

dried in the sun and then stored carefully against the attacks of white-ants. The ground where seed is to be planted is tilled and pits of three cubic feet are dug at a distance of 6 to 8 ft. They are then filled with dried leaves and set on fire. After the lapse of a few days, to enable the pits to cool down completely, the seeds are put in and fully covered with earth and this is covered with dried leaves, to keep the temperature low. These processes take place between the months of November and February, according to the conditions of the localities. Till the seeds put forth shoots, they are not watered, but occasional showers after their appearance nourish them, and make them so healthy and strong as to stand the violent South-West Monsoon and become luxuriant under it. They are then heavily manured with cow-dung and green leaves. In the course of six months from the time of planting, they flower, and in three months more, the bunches will be ready for use. There may be a difference of one or two months.

"At the present moment the only portion of this plantain that is made use of, is its fruit, and it is the favourite plantain in Cochin and Travancore. It is exported in large quantities to various places outside their limits. The natives of the country cannot do without them, during festive occasions. As bananas are to be had only between the months of August and December, they are preserved for use at other times. The fruits are preserved in honey to a small extent. The raw plantain is cut into slices, after peeling off the covering rind, dried in the sun and taken care of against the rainy weather. The flour into which the dried slices are converted, is considered to be a nutritious and harmless food for children, and is placed by the natives on a level with arro[illegible] The slices of fruit, are als[illegible] in oil or *ghee*, put into fresh [illegible] en vessels and preserved [illegible] natives of the country. It w[illegible] of interest to state that th[illegible] the article of food which [illegible] great African traveller, th[illegible] Sir Henry Stanley found in large quantities during his march through "Darkest Africa" and carried with him for the use of his followers.

"I have digressed to this extent to demonstrate the existence of an important industry, and the advantage that may be taken of it to create another. I again emphasise that the only produce taken by the ryot from this plantain is its fruit. From a rough calculation I have made, about 5,000,000 plantain stems capable of yielding [illegible]

tons of fibre, are thrown away in about twenty *taluqs* of Travancore. To this may be added 1,000 tons derived from other species of plantains. Thus, the total of 3,000 tons is capable of yielding an income of Rs. 7½ lakhs at the rate of Rs. 250 per ton. This is a modest figure, and it ought to double itself. Even in calculating the outturn of fibre from each plantain stem, I have put in only a minimnm of half a lb., though it is possible to double the quantity with care and experience. The Travancore ryot is not directly profited by the cultivation of the banana. On an aver- ... gets a little more than two ... on every bunch, while his ... on the East Coast gets four ... the value on other species. ... re of ground will contain be- ... 1,500 and 2,000 plantains, ... will yield an income of Rs. ... o Rs. 250, which will just cover the cost of cultivation. But the profit which the Travancore ryot obtains is by raising yams and other annuals in the ground between the plantain trees. If he would make use of the stems for extracting fibre, that industry will put into his pocket more money.

The impression has been left in my mind from the study of this subject that the Deltas of the Cauvery, Kristna and Godavery are well-fitted for the cultivation of the banana. The one important condition absent in those places is the South-West Monsoon, but the freshets, with a large quantity of alluvial soil that is carried down these rivers, are sufficient to make up for this. I know it for a fact that landowners on the banks of the Cauvery, raise plantain crops once a year, taking advantage of its freshets. I also think that the Gangetic Valley and the country fertilised by the tributaries of the Indus are fit for the cultivation of the banana.

It is not my object to pursue the subject further and speak of the cultivation of other varieties of plantains. I shall only refer to the Manilla plantain, which produces the celebrated hemp of that name. Mr. Venkatarama Aiyar thinks that it is not an exotic plant and identifies it with the "*Kottay Vatha*," or the seed plantain found in the Tanjore, Trichinopoly and South Arcot Districts. The Superintendent of the School of Arts, Trevandrum, calls it the "*Mala Vazah*," or hill plantain. I know for certain that this species is not to be met with in the forests of Travancore. I have tried it at Quilon, not far away from the beach, and at Adienkavu, close to Shencottah, at an elevation of about 1,000 feet above the level of the sea. It takes kindly to the soil in both places, but it has found the latter more congenial. Its growth

there is luxuriant and it throws out a larger number of suckers; in the course of a year, I found around the parent stem about ten shoots. With heavy manuring, the family can be increased. But the great drawback at the place is the havoc committed by wild pigs, which bore through the soil, devour all the yams and thus retard the constant putting forth of shoots. At Quilon, it has not to contend against any enemy, but it wants watering during the hot months from January to May. It repays trouble as it grows to a height of 13ft. and swells to a girth of about 3 ft. In estimating the average elastic limit of each fibre of a number of varieties, Mr. Narayana Aiyar does not speak favourably of the Manilla plantain I sent to him from Quilon. I think that there must be some age limit to the plantain whose fibre is extracted that it may be of any economic value. The one which I sent to him to the School of Arts was fully matured, and I think it ought to have been cut earlier.

THE INDUSTRY AT TANJORE.

N. Swaminathen of the T. A, and Industrial Institution, Tanjore, writes to the "Madras Mail":—In your issue dated the 18th appears the interesting communication from Mr. T. Nonnombalan Pillay, of Travancore, on the plantain fibre industry. He states therein that the improved machine, made at the School of Arts, Trevandrum, and Mr. Venkataramier's machines cannot be placed at the disposal of the ordinary ryot as they are not easily portable, and on account of their prohibitive cost. Your readers, I believe, are aware that the Tanjore Agricultural and Industrial Institution has taken to this industry in right earnest. The institution sent a man to Melros to study the process of ex fibre from plantain sheat returned here a month a since then he has been ex fibre. The machine used he only Rs 2-2. The local ma rers have up to now supplied some twelve machines at this rate. It cannot be said that it is beyond the means of any ordinary ryot; and I daresay if machines are made on a large scale they can be made still cheaper. Permit me to say a word or two respecting Mr. Ponnambala Pilay's statement that Mr. Venkataramier's Trevandurm machines are prohibitive and not portable. Mr. Venkataramier's machine is certainly portable, but I think it cannot be obtained for anything less than Rs. 15 or so.

may add that one is able to extract more quantity of fibre with greater ease with the local machine at Rs. 2-2 u ed by this institution than with that of Mr. Venkataramier's, which costs about Rs. 15 or so.

PLANTAIN INDUSTRY IN TRAVANCORE.

Mr. M. S. Tiruvaryan Pillay the "Madras Mail" regarding plantain fibre industry:—

The industry has been ally tried in Travancore by Ponnambalam Pillay, S., while he was officiating as Conservator of Forests; (2) detailed information on the subject is given in a booklet written by the above-named gentleman, entitled the Forest Wealth of Travancore, of which copies can be had from the author, his present address being—Assistant Superintendent of Police, Quilon, Travancore; (3) the machinery for the extraction of the fibre is extremely simple in design and construction and could be had for Rs. 3 in the School of Arts, Trevandrum; (4) a mechanic with average intelligence can learn the work in a fortnight's time. With the kind permission of the Dewan, persons willing to learn the work might do so at the School of Arts, Trevandrum, or from Mr. R. L. Proudlock of Ootacamund; (5) samples of cloth might be obtained from the Superintendent of the Sri Mala Rama Varma, Technical Institute, Nagercoil.

PLANTAIN FIBRE CLOTH.

A Tranvancorian writies to the "Madras" Mail:—In reply to a letter published in the "Madras Mail" of the 30th ultimo over the initials "V. K. G"., who expresses doubts as to the plantain fibre cloth admitting of constant washing like ordinary cotton cloth, I may inform him that no doubts need be entertained on the point. Several of us in Trevandrum are using plantain fibre cloth as turbans which are washed like other cotton fabrics, and are all the better for the washing. These turban cloths are made at the local School of Arts, by Mr. N. Narayana Pillay, L. T. M., of the Victoria Technical Institute, Bombay. Towels and handkerchiefs are also made and

command a rapid sale. The fibre, when coarse, can certainly be used for cordage and ropes.

FIBRE EXHIBITED AT THE CACHAR EXHIBITION

A correspondent writes in the Sylhet "Chronicle":—In the Class II. produce under section Agriculture, there were exhibited some plantain fibres by Babu Man Gobinda Choudhury, Joint Secretary to the Cachar Agricultural and Industrial Exhibition. These fibres elicited the admiration of the visitors. I give below the method of extraction which I hope will interest your readers.—"The leaf sheaths were passed through a sugar-cane mill with smooth rollers, then combed on both sides with an iron comb which brought out most of the cellular substance. The blunt edge of a sickle was afterwards used to get more of the cellular substance out. The bundles of fibre were then washed in water and soap and afterwards boiled with alkaline and soap and then were rinsed in plain water, wrung and exposed in thin layers to dry in shade. The bundles of fibre were exposed to dew for three successive nights and in the day time. the drying proceeded in the shade."—Although the fibre is much inferior to Manila hemp, it is worth at least twice as much as jute. The fibre can be used for making ropes, mats and paper.

A SIMPLE PROCESS OF EXTRACTING FIBRE

In view of the every day growing interest of our countr
plantain fibre industry, w
here a process, whereby fil
be extracted from planta
with rather little difficulty.
banana tree will yield fil
the species which is kr
Bengal as "*Ento-Kala*" (
yields the best, in length, strength and quantity. Take a piece of the coating of the trunk, cut it into several pieces lengthwise, reject the inner side and keep the outer one. Steep the same in water for five or six days and the fibre will looen of themselves and the back part will look like white tape. Neither of them will discolour when steeped in water. Now, wash the loose fibre in water and dry up the tape-like part in the sun. Rub the fibre while wet with cloth and they will look like silver wires. Dry fibres when steeped in lime water

yellow colour. The process has been tried more than once, and, says the "Swadeshi Sampad," if properly followed, it is sure to yield good results.

OBSERVATIONS OF AN EXPERT

[Mr. Manindra Nath Banerjea, Agricultural Chemist, at present tutor-gurdian to Kumar Janak Nandan Singh of Nurhan.]

The introduction of chemically ed German indigo into the having told heavily upon the indigo trade, the growing ointment among planters ed tbem to think of some industrial enterprise to make the loss found inevitable sequence of the fall in the of Indigo. Of all the enterprises taken up by the Indigo Planters, that of the vegetable fibre may be ranked as one of no small importance. The Rhea plantation having proved somewhat successful, some of the planters took it also in their heads that the plantain and banana may be utilised for the development of an industry, as they form, as is well known from the earliest times, the latent sources of an immense quantity of fibre. The high importance of the plantain fibre industry, as suggested by Dr. King of the Royal Botanical Gardens, attracted the attention of many agriculturists and it led to the design of several decorticating machines, both in this country and abroad. The primitive machine, as used by the Philippine Islanders, is very simple while the latest invention of a machine (nearly perfect of its type) by Messrs. Death and Ellwood, Liecester England gives considerable doubt regarding the successful working and manufacture of the fibre in India for its development into a profitable industry.

About the beginning of the year 1903, I applied myself to a close study of the plantain and its products and especially the fibre. The type of Musa that grow largely in India is that of *'Musa Sapientum'* as distinguished from *'Musa Teztelis'* which yields Manilla Hemp of Commerce. The existence of fibre in it and its utility has been known in India from the ancient times. * * * First of all I set a machine of the primitive style in a neighbouring Indigo Concern, the proprietor of which takes a good deal of interest in fibre industry, and worked at it for about a month. This attempt was quite unsuccessful inasmuch as the daily outturn was so hopelessly small that to start an industry was altogether out of the question.

Next, I devised some machines myself for the extraction and cleaning of the fibre, but the difficulties that always stood against success are the great complexity of their construction and the mucilage of the stems clogging the parts of the machinary, rendering the work intermittent and the outturn very small. These difficulties could not be eliminated out of any machine and so, after all, I had to give up the attempts to get a large supply of the outturn by machinary.

Being a student of chemistry and fond of researches, I at once applied myself to the finding out of a chemical process, which will do away with all machines and the difficulties appertaining thereto, and will also bring out a large outturn offering suitable conditions for making it the basis of a most profitable industry in India.

A chemical process of extraction of fibre from Plantain stalks means the use of certain chemicals in such a way that, they can act upon the mucilage only and not on the fibre itself, either by dissolving it or softening it to such an extent, as to allow the fibre to part with it very easily such as either by washing it in water or in another chemical solution without injuring in the least, the strength of the fibre itself or its colour.

The process has since then been discovered and made complete in every respect. It is quite scientific and based upon a close rational study of the natural type of putrefaction in the vegetable world, known as spontaneous fermentation or putrefactive fermentation. Practically the process will defy all competition by machines hitherto invented. The idea that chemicals injure the strength of the fibre is literally removed; and it has also been proved that, the fibre obtained by my process is superior in texture, quality and strength to that secured by means of machines. Scientific principles have developed the strength of the fibre con ably. My process gives different kinds of fibre.

No. 1 may be used and for making cloths.

No. 2 can be used fo same purposes as jute, and industry is successfully established, it will prove a rival to jute.

No. 3. and No. 4 can be best used for cordage. Besides, the refuse can be used in paper-making. So there is absolutely no wastage in the process. Samples of these different kinds of fibre have been shewn to several European merchants who are in great sympathy with this new Industry. The London market has valued this No. 3 and 4 fibre at £7 to £10 per ton. I send herewith the opinion of a Calcutta

firm' in the matter. The No. 1 fibre, so far I can say, will fetch Rs 8 to Rs. 10 per maund i.e., £14 to £18 per ton. Thus from the extraordinary simple nature of the process, by which it is obtained and the equally extraordinary cheapness, it may be considered the most successful and easy means of establishing "Plantain fibre Industry" in any place in India, where there is a large supply of plantain trees. In my next, I shall give distinctly all its advantages over the machines hitherto invented.

VANTAGES OF THE CHEMICAL PROCESS OVER MACHINES.

n Machines :—

utturn ;—Small; incapable of evelopment of an Industry.

Work :—Intermittent; the mucilage clogging the part of the machinery; requiring thorough clearing of its parts every now and then.

3. Plant and appliances entailed :—Heavy and cumbrous; often go out of order; cannot be removed easily from place to place, owing to its weight.

4. Fibre :—As strong as ordinary plantain fibre can be; the length of the fibre is limited; parts broken by machinery. The sap of the mucilage, which affects the strength of the fibre, cannot be easily removed. On the whole, it did not give satisfaction in the market. Cannot be used for the same purposes as jute.

5. Outlay :—Large.

6. Usages :—Cannot be adopted by ordinary man. Hence the industry is not within the reach of ordinary ryot.

In Chemical process :—

1. Outturn :—As large as may be desired. The supply may be extended at the option of the operator. Practically the supply is unlimited provided that the supply of trees is unlimited.

2. Work :—Continuous—Just like the manufacture of bricks in Bull's Kiln.

3. Plant and appliances entailed :—Nothing required. No machines necessary.

4. Fibre :—Made stronger and more durable by practice of advanced chemical principles. Superior in texture, quality and in every other respect to those obtained by machines and the natural fibre. Gave nearly every satisfaction to the market. Four different kinds of fibre are obtained by the process. Can be used :—No. 1 for cloth making. No. 2. for all purposes for which jute is used (can hardly be distinguished from jute),—

No. 3 and No. 4 for cordage, matting, Durries etc. The refuse as paper-material. No. wastage or loss of any kind.

5. Outlay :—Very small, rendering it within the reach of all classes of people. The industry can be established either in a very small scale or in a very large scale.

6. Usages :—Can be used anywhere if there be a large supply of plantain trees. Can be universally adopted by anyone from the rich Zemindar to the common ryot.

Absolutely cheap hence quite lucrative

OPINION OF A CALCUTTA FIRM (EUROPEAN) ON THE FIBRE OBTAINED FROM THE CHEMICAL PROCESS.

"The samples you handed us have been examined by several firms with whom we have dealings with fairly satisfactory results.

"It is thought that your No. 2 fibre could be used for the same purposes as jute and would realize about Rs. 5 per maund, probably Rs. 5-8 or more if the improvements we mentioned to you were brought and in this connection, we think, your No. 1. Fibre might answer and fetch from Rs. 5-8 to Rs. 6 per maund."

I did not send any sample of No. 1 fibre. The company guessed its probable price by testing the No. 2 fibre. No. 1 fibre is far superior to No. 2 and it may fetch from Rs. 8 to 10 per maund.

"We have been requested to forward 2 maunds of your No. 2 fibre to a large Mill for trial and we think it would be just as well to also forward, say one maund, of your No. 1. We could then advise you more definitely as to their respective market values.

"We do not think your Nos. 3 and 4 fibre could be used for the same purposes as jute, but it a[ppears] to make a fairly good r[...] and we shall make further enqu[iries] in the direction. If found suit[able] which we think it will be, it w[ill] fetch about Rs. 3-8 to Rs. 4 [per] maund.

"But as we have already informed you, an outturn of 4,000 maunds per annum (The company wanted a large annual supply at once. I told them that for the present, I could try my best to supply 4,000 maunds only. Upon this they remarked in this manner) would only be as a speck on the ocean and would not be appreciated. It would be entirely lost, amongst the hundreds of tons of jute (The No. 2 fibre can hardly be distinguished from jute, and if the industry is established, it will surely prove a rival to jute) placed on the market

annually. Unless the outturn was appreciably large, there would be no demand for it, in fact no inducement whatsoever to consumers."

How to propagate the industry in India.

The Indian ryots' general ignorance of the existence or fibre in the plantain stems (morphologically it cannot be called the stem, for plantain and similar kind of trees have got no true stem. The so-called stem is really composed of the broad, imbricated clasping leaf-
...s) prevents him from making
...f it. Those who know of it at
...ould not try for its use, for want
...roper appliances or process,
...d to their means, for extract-
...he fibre. Now that my chemi-
...rocess is within the reach of all classes of people, the difficulties towards the manufacture of the fibre have been done away with and it may be reasonably hoped, therefore, that those who are anxious for the development of an industry in plantain fibre should bestir themselves as to the propagation of this Chemical process, after a fair trial. There can be no question as to the abundance of plantain trees in this country. People grow them in this country not for the sake of their fibre but for the sweet fruit they yeild. In fact they form one of the most useful of plantations to the ryot for their great utility. The importance of the cultivation is well known in every part of India, so no attempt towards this direction will be necessary. The creation of a demand and appreciation of the fibre is what should be aimed at. An increasing demand of fibre in the market may admit of an indefinite extension of the plantation, but for all present purposes, the existing cultivation will quite suffice, inasmuch as the large number of trees that are annually cut and thrown away can easily be utilized for the manufacture of several millions of tons of fibre. To bring this to a successful issue requires :—

(1) The prevention of wastage of trees cut and thrown away annually in every part of the country, making each one realise the existence of the fibre in them and the possible value that they may fetch.

(2) Making use of the "Chemical Process" it being the easiest and cheapest process of extracting the fibre from the stalks.

(3) The accumulation from different places of the fibre thus prepared, the transmission thereof to a central station, to see to their enshipment to a foreign country and their utilization for such purposes as cloth-making, manufacture of cordage and similar kinds of industry. The above may be

effected by each of the three following distinct ways :—

(a) By purely native enterprise under foreign capital.

(b) By foreign enterprise under foreign capital.

(c) By Government enterprise out of State Funds.

(d) By combined enterprise both of the Indians and of foreign nations under Government patronage and support.

This may be illustrated thus :— An association consisting of men of culture and wealth may be formed with its head quarters at Calcutta, for example, and agencies may be established under proper supervision and management in different parts of the Province, where there are large plantations of plantain.

The work of each agency will be duly specified—(1) in visiting each plantation, (2) in making a rough estimate of the supply of trees that can be secured from each out of the wastage which every proprietor annually cuts and throws away, (3) in making arrangements for the collection of these trees to a place very near to each plantation where the fibre will be extracted by the chemical process, (4) in carrying them to their own station quarters where they will be treated with the rest of the process necessary for bringing the fibre upto the derived state and (5) transmitting them to the head quarters at Calcutta.

A careful examination of the scheme thus laid down will show that those who are interested in the industrial development of the country, could easily adopt it and bring this to a successful issue. The difficulty which will be experienced at the outset will gradually vanish till the whole thing will act like a machine. For my own part I can boldly assert that if my countrymen extend their hearty sympathy of head and heart and purse towards this important movement, the may be considered quite l with a profitable return.

Regarding foreign ent I have nothing to speak of that if outside capitalists at an taking up the industry it is sure to be successful at their hands. To indigo planters it will prove a lucrative business—for the reasons of this opinion, vide my book entitled 'Plantain and its Products—Basis of a new Industry in India.'

In conclusion I must needs appeal to the generosity and patriotism of our countrymen of wealth and culture so that they may take time by the forelock before it gets too late and the industry passes off to foreign capitalists with whom it may not always be possible to compete in the long run."

SOME FURTHER DETAILS.

Melrosapuram School.

ACCOUNT OF THE WORKING OF THE INDUSTRY THERE.

The Rev. A. Andrew of Chingleput, Madras, in his booklet "Indian Problems" (to be had of G. A. Natesan & Co., Booksellers, Madras, Price As. 12) observes as follows :—

"The plantain fibre industry in South India promises to become a ble business. Enquiries as v to extract it have reached m various quarters, showing erest that is now being awa- to the value of the once led plaintain stem. After the ıs fruit has been cut off, it used to be thrown on the rubbish heap as utterly worthless. But it is different now, since cultivators have begun to realise how much they were losing by their former wasteful practice. The fibre can be made into ropes or woven into cloth. At the Melrosapuram Agricultural School near here, the fibre is being extracted and made into ropes.

It may be interesting to some to learn something of the nature of the fibre which is being extracted. Some time ago a piece of rope was sent to me from the above school. Another piece of rope was sent to me by the Deputy Superintent of Chingleput Reformatory School.—This was made of hemp of Calcutta. These two ropes were tested by me to ascertain their breaking tension strength. The following is the result :—

Plantain fibre rope	Hemp rope
Length, 12½ yards.	14 yards
Thickness, $\frac{5}{16}$th of an inch.	$\frac{9}{32}$ of an inch.
Weight, 83 pallams, or 6 lbs. 10¼ ozs.	10 pallams, 12½ ozs.
Breaking tension 230 lbs.	286 lbs.
Price, Re.1 per viss. or 3 lbs. 2 ozs.	Rs. 1-4-0 per viss.

It will thus be seen that the hemp rope is somewhat stronger, but is 20 per cent. higher in price. The strain which the plaintain fibre bere is remarkable, and it shows that plantain fibre rope is about as good for all practical purposes as the hemp tree. Its durability and powers to resist wear and tear have yet to be put to the test, however. My impression is that a fibre which can bear such a high tension will be found to be durable. This fibre has a white, glossy appearance, and the ropes made from it have a very attractive look.

Each plantain stem can produce on an average about 40 oz. of fibre, and 600 plants can be grown on an

acre. Each acre will, therefore, produce 150 lbs. or 48 viss, of fibre. This at Re. 1 per viss will give Rs. 48 per acre. A boy on 2 annas wages a day can extract fibre from five stems. An acre will give him work for 120 days, and this will cost Rs. 15. The charge for spinning the fibre into ropes by hand is about 6 annas a viss. And hence it will take Rs. 18 for wages for a man to spin the fibre got from an acre. This could be done much cheaper by a spinning machine and in a shorter time. The hand process takes 120 days for an acre. If the expenses incurred in extracting and spinning be deducted, the sum of Rs. 15 will be got as profit from an acre of plantain cultivation. This amount of clear profit is as much as the average value of all food-crops grown in South India, per acre, and is a distinct addition to the income derived from the plantain fruit and shoots. Besides, the refuse from the stems when the fibre is being extracted, the leaves, and every other thing connected with the plantain, are returned to the soil as manure. Only the fruit and the fibre, with some of the tender leaves and the tender heart, are taken and sold. Thus nothing is lost in this process.

In addition to the saving and profit got from the fibre produced by an acre of plantains, two hands are employed for 120 days each, thus providing two new occupations. Plantain gardens, if managed as they ought to be, can be very profitable, and become a constant source of income while they are under cultivation. Turmeric takes about a year to reach maturity, and so does sugarcane, but once a plantain garden begins to bear fruit, the fruit on all the trees does not mature at one and the same time. Some bunches appear before the others, and hence there is a constant maturing of bunches one after the other going on. These are sold as they reach the stage when they can be cut from the tree. In this way money is cor coming into the hands cultivator, which is very gr to him. It is not so witl products of the soil. Pl are universally used for and hence there is a constant demand for green fruit from plantain gardens.

From the enquiries made from Calcutta and Behar it is apparent that growers there are still carrying on the wasteful practice of casting the stems on the rubbish heap after the fruit has been obtained. Such questions as these are being asked:—How is the fibre extracted? Is it the stem that is used after it has fruited? From what part of the stem is it taken? Is any particular kind of plantain required? What can be made of

the fibres, and where can they be sold? A Calcutta gentleman writes;—"I have extensive plantations, but hitherto I have not done more than sell the fruit and the leaves. As the extraction of the fibre promises to become a profitable industry, I should like to make myself acquainted with the process. Will you, therefore, kindly favour me with the information I seek?" Another writes:—"On one point I require more information than what you have been pleased to furnish; I mean that the process of extracting fibre has not been as clearly explained as to enable a general reader to try his
the new enterprise by way
riment. I shall feel highly
f you would be so good as
sh another letter throwing
this point for general information."

With regard to the particular kind of plantain which can be used for extracting fibre from, the best is the *Musa textilis*, or Manilla hemp plantain, so extensively grown in the Philippines for fibre alone. Its fibre is stronger and better than that of any other species. It cannot, however, be grown for its fruit, and that is worthless. On this account it would not be a profitable industry in India, where the climatic conditions are less favourable for its culture than those existing in the Philippines. Another reason against its introduction into the existing plantain topes is its tendency to spoil the fruit of other plantains which are grown for their fruit. Of this a certain writer says:—"It is useful in the garden if much grafting is done, because the fibre in the leaf stalk is stronger than that of the common banana, but it should not be planted where the plantain is grown for fruit, because its pollen will fertilise the ovules of the other species, and the result will be abundant, hard, black seeds as large as peas in the fruit that without fertilised ovules are such delicious fruit."

Great care, therefore should be taken by those who cultivate plantains for fruit to exclude the *Musa textilis* from their gardens. It might be tried on the West Coast for its fibre alone, where the rainfall is abundant, and where it might be made to pay. But I fear that plantain growers must be content with the ordinary species for fibre and fruit, as well as for the many other uses to which the plantain tree can be put. The return that the ordinary species gives for the labour expended on their cultivation is sufficiently encouraging and hence the most should be made of them.

The following are the species which are most frequently grown,

and which are being cultivated in our school farm :—Bonden, kattei bonden, Rustàli, Pey vazhei, Puvazhei, Raja vazhei, Nir bonden, Sevvazhei, Pacchei vazhei, Uthira vazhei and Bengala vazhei. There are several other varieties besides these. One of the most notable is the Morisu vazhei, or the Mauritius plantain, whose botanical name is Musa cavendishii. It is a dwarf plantain and seldom grows more than 6 ft. in height. It thrives well, and is surprisingly productive, having very large bunches for its size. Some of the bunches are so heavy in our garden and hang so far down as to touch the ground. Though the dwarf species is so productive of fruit, it is deficient in fibre, owing to the shortness of the stem, and it will hardly pay to extract it, if this species be cultivated only. The short stem, however, can be taken and the fibre extracted from it along with that of the other kinds.

It is the stem that is taken after the fruit has been cut off and cut into lengths of about 3 ft. These are then divided into strips about 2 ins. in width and placed at the side of the machine for extracting the fibre. These strips are taken one by one and put under the knife and pulled through. Each strip is pulled through several times until all the soft stem-substance is removed from the fibre. The fibre is thereafter dried in the sun and put aside for the manufacture of cordage and ropes, or is taken and woven into cloth where it is possible to do so.

It is rather difficult, in the absence of diagrams, to describe the machine, which I understand is largely used in the Philippines to extract the Manilla fibre. It is a simple contrivance. For a full description of it I would refer all interested in the subject to the Bulletin written by Mr. Proudlock, Curator of the Government Botanical Gardens, Nilgiris, and sold by the Government P[illegible] Madras, for a few annas. [illegible] contains all the inform[illegible] needed, and has diagram[illegible] illustrate the remarks made [illegible] the machine.

The fibre of all the plantains cultivated for fruit is useful for making cordage. Once the public realise that cords and ropes made from this kind of fibre are strong and can be utilised for the many purposes that hemp ropes are used, they will not hesitate to spend money in buying them. There is an extensive market for ropes in India, and then there is the demand that may be created in European countries for the fibre as soon as a sufficient supply is forthcoming.

FIBRE MACHINARY.

Fibre Decorticating Machine. —We have received a sample of Sisal hemp, decorticated in a new patent machine made by Messrs. Burn and Co. Ld. The leaves are fed into the machine and go right through, there being no pulling out and reversing, and the fibre is practically clean on delivery, a slight washing removing any scraps left adhering, and after it is dried in the sun, the result is the hemp presented to us. The machine will tackle about 40 to 50 leaves ıinute, but it is hoped that in ar work and when the attend- got used to it, the output probably be doubled or trebl- The same machine will also Rhea, the only thing necessary to alter being the setting. This fibre being much finer requires nicer adjustment, but that is all and this can be done in a matter of a few minutes. The machine is in their works and they would be glad, we are told, to let anybody see it and to give any further particulars asked for.' Amrita Bazar Patrika.

Aloe Fibre Decortication.—A successful experiment in decorticating fibre from aloe leaves, with the help of the decorticator, erected by the Eastern Landing, Clearing and Forwarding Co., took place at No. 25, Strand, Messrs. Marshall Sons and Co. having erected the necessary motive power to drive the machine. There were a few gentlemen present. interested in the development of this industry. The machine is built lightly, so that it is easily portable and suitable for jungle districts, where it is necessary to work it. The decorticator is worked in a very simple way. The leaves are fed into the machine in their raw state and withdrawn, the pulp having been removed leaving the fibre, which is afterwards washed to make it suitable for the market. It takes three-quarters of a nominal horse-power to work it.

MACHINERY AND PLANT.

THE TANJORE AGRICULTURAL ASSOCIATION

A very attractive feature of the Exhibition is the implements now at work in some parts of the District for extracting fibre from plantain trees and the making of ropes from it for agricultural and domestic purposes, as were also the lace cloths prepared by the Tanjore Agricultural Association from the same materials. 'The process of extracting the fibre and manufacturing it into rope, was per-

formed before the visitors. The Argicultural College at Saidapet sent several kinds of ploughs and implements such as chain harrows and fodder cutting machines. Implements of husbandry in use in the Ceded Districts, such as seed drills, "guntakas" and bullock hoes, which the Association had already introduced into the District, were shown, the method of using the seed drill being demonstrated in a garden adjoining the Exhibition.

According to an official report from Madras there are signs of the plantain fibre and Manilla hemp industries being taken up on a widely extended scale, and some companies have been formed to exploit these products. The demand for simple machines for extracting plantain fibre and for trained men to teach and work them continues brisk in Southern India, where thanks to the initiative of the Argicultural and Botanical Departments, considerable interest has been evoked in the industry. Those concerned in the plantain fibre industry in Bengal may be interested to learn that some of the Madras machines have already been demonstrated at Pusa, where the results of their working may be worth enquiring after.

Machines for extracting plantain fibre are now being manufactured in the Cannanore Central Jail, each machine being priced at Rs. 20.

The young Maharaj Rana of Dholpur is among the inventors who have filed specifications of inventions which they want protected in the Patent Office, Calcutta. His Highness, in conjunction with Mr. H. C. Clogstoun, Superintendent of the Dholpur State, and Mr. A. N. Thorpe, a Civil and Mechanical Engineer, of Dholpur, is the patentee of an improved fibre or flax extractor. This is one of the happiest signs of the times.

December 1905.

The efforts of American Scientists have led to the inventio[illegible] number of fibre extracting[illegible] ances. There is scarcely a[illegible] trunk, root of a tree or le[illegible] fibres of which cannot be ext[illegible] by machines. The machines made by Thomas Barraclough of London are believed to be suitable for all kinds of fibres.

ALOE FIBRE MILLS.

"There are two mills at Madhupur on the E. I. Ry. for the purpose of extracting aloe fibre, and one is worked by an engine. We are informed that the speculation is paying handsomely." A. B. Patrika.

PLANTAIN FIBRE MACHINE.

A DEMOSTRATION AT KUMBAKONAM.

Kumbakonam, 24th Dec. 1904. —It may be said that there is a growing desire amongst the general public of the Tanjore District to know all about the plantain fibre industry, which the Tanjore Agricultural and Industrial Association has introduced into every part of the District. In July last, the Association sent some intelligent men to Melrosapuram to learn the manufacturing methods of the , and the use and the work- he mechanical appliances d in extracting fibre and turing articles out of that . Those men returned 1 with necessary knowledge of the Industry and the methods of its operations gained under the instruction of the Rev. A. Andrew and his men; (vide article on "some further details" before) and on their return they applied themselves to the spreading of the knowledge they had brought with them. Their services were in constant demand by some of the proprietors of large estates in the District who wished to try this industry; and cheap and simple machines were made for extracting fibre from the stems of plantain trees, and the working thereof explained.

A superior machine upon an improved plan invented by Mr. A. G. Gannapathy Iyer, Mechanical Engineer of Tinnevelly, is making its way into the District; and it fairly promises to replace the crude and the simple machine introduced by the Tanjore Agricultural Association as the first step in the direction. This machine was awarded a gold medal in the Madras Industrial Exhibition of 1903.

The machine was exhibited by the inventor at the Porter Town Hall of Kumbakonam yesterday evening. It is also simple in the principles and the methods of its working. A cast iron flat wheel 13 in. in diameter and 14 in, in circumference, fitted to an axle mounted on a wooden frame, has a slit across the face of the whee into which one end of the plantain sheath, divided into a number o longitudinal pieces, each piece measuring 1½ in. in breadth, and 3 ft, in length, is inserted one at a time. This is held tight by a clip fitted below the slit to one of the spokes of the wheel, and the whee is turned round by a handle, the sheath being subjected to a scraping action of a blunt knife on the top of the wheel, and the pressure of the knife on the sheath being regulated by a lever handle. Th

mucilages are scraped out thoroughly by the knife as the wheel is revolved, and the lustrous fibre comes out, arranged beautifully evenly, on the surface of the wheel, in uniform length. The fibre is taken out by loosening the clip and another sheath is inserted and the process above described repeated. Anyone who works at the machine for a few minutes would be able to extract fibre with ease, and when well practised, he could extract to the extent of three quarters to 1 lb. of clean fibre per hour. One can work the machine without fatigue for eight hours a day. The uniformity of the fibre from one end to the other, with the least breakage or wastage, the ease with which the machine is worked, and its adaptability to be driven by steam or any other power wherever available, are said to be the special merits of this machine. The cost of it is Rs. 35 complete for hand power. The inventor has applied to the Government of India for a patent to whom he has submitted a specification of his invention as called for by them. The demonstration with this machine took place before a large gathering of eager spectators; and some orders were given on the spot for the supply of machines.

If there is one industry, more than another which fits in with the means of the people of this District, and which at the same time has a really promising future before it by reason of the boundless possibilities of its development, it is the plantain fibre industry. In no other place is the raw material for it to be found in such abundance as in the Tanjore District, where it is a common occupation of the people, next of course to the cultivation of paddy. The plantain trees are reared in rich luxuriance in the intervals of space between paddy fields on the banks of the rivers and canals, and in house sites and backyards. At present, it is only the leaves and that are at all used, tl being thrown away in ig their value; but it is stems that the raw ma this promising industry are obtained. The Tanjore Agricultural and Industrial Association has made from plantain fibre several articles required for domestic and agricultural purposes; and their finished products of ropes of all sorts were on view at their recent Exhibition. Finer manufactures of cloths and turbans, etc., from materials, and labour and skill locally supplied, were also exhibited. It must have served to open the eyes of the people to the limitless possibilities of this industry, in regard to which there is evidently a general desire for information; and when in actual practice it is found, as it is

bound to be, that the industry in its full development will constitute a substantial source of material prosperity to the District, the congestion on profitless agriculture, which is at present the only occupation of the people for want of others, will have been sensibly relieved, and the thoughts and energies of the surplus populations employed on many of the profitable pursuits that this industry will have opened up for them in the first instance.—"Madras Mail."

PORTABLE FIBRE MACHINE AND SCHOOL OF ARTS, TRIVANDRUM.

Mr. Krishna Prasad Narain Singh Muzafferpore, Proprietor, Hardi Estate. (July, 20. 1905) writes in the Amrita Bazar Patrika :—

I have received the following note from the Superintendent School of Arts, Trivendrum, in answer to an enquiry made by me, re plantain fibre.—

"The Portable fibre extracting machine, that is made here, costs Rs. 9½. One man can extract nearly one to two lbs. of fibre per day, yielding about 4 to 6 oz. of fibre from each tree. The loom to weave into cloth is quite similar to the one used in weaving other stuffs, but a little modified in its details. As the fibre is too brittle for wrapping, ordinary flyshuttle looms cannot be used. The extracting machine is very simple in construction and so, any workman will be able to work with it after a slight practice."

I hope the above note will interest those who actually intend taking up plantain fibre industry. I shall soon get a machine from Trivendrum, and intend to send a few samples of fibre to the forthcoming Benares Industrial Exhibition as well as to the Sonepur Exhibition which Mr. Lyon, Commissioner of Patna, is trying to get up in December next. I also intend sending fibre samples to Mr. Shafi of the Panjab to which I hope he will give a fair trial with his new handloom. I had the opportunity of visiting many rural tracts both in East and West Bengal and I, daresay, there are ample areas, now lying waste, which can be conveniently turned into good plantain farms. So if energetic Bengalee agriculturists would be a little more earnest and take up the question a little more seriously they will find in plantain a very beneficent goddess.

PART VI.

COMMERCIAL AND SCIENTIFIC TIT BITS.

GREAT DEVELOPMENT OF INDO-GERMAN AND GERMAN INDIAN TRADE.

THE Foreign Office has issued an important report on German trade with India, which has been compiled by Sir William Ward, Consul-General for Great Britain at Hamburg. He states that the trade between Germany and India has during the past decade, experienced a marked development, the total value of the annual imports from India to Germany having, during this period, increased about 50 per cent, while the total value of the annual exports from Germany has increased about 100 per cent.

Indian official statistics show that Germany now ranks third in importance among the various countries of the world both in the value of the import and of the export trade of India. At the same time Sir William Ward points out, it should be remarked, that the share taken by Germany, more especially in the import trade of India, is still very far behind in importance compared to that taken by the United Kingdom; for the share of the latter, for instance,in the year 1904, amounted to 65 per cent (and that of Austria-Hungary to about four per cent) of the total Indian export trade while the share of Germany was only four per cent. As the export trade of India, tl taken last year by Germ about nine per cent, wh taken by the United Kingd 27.5 per cent, the country which held the next most important share in the Indian export trade having been China—namely, 12.6 per cent.

German official statistics show that the total value of the imports to Germany from India in 1904 amounted to £14, 745,000, and the total value of the exports from Germany to India £4,165,000, both figures being largely in excess of the figures for the year 1902. These figures refer to the trade of India with the German Customs Union only, and consequently the trade carried on, specially between India and the free-port districts of Ham-

burg and the other German seaports where these free districts exist, is not altogether comprised in the statistics. For, though a large proportion of the goods imported into and exported from these free districts (respectively from and to India) are merely goods in transit destined for or derived from the German Customs Union, there is also a certain proportion of goods imported into the free districts which, after being stored or handled there in some other way, are re-exported again thence direct to foreign countries without entering the Customs Union.

[illegible] Consul-General adds that, [illegible]able as the total value of [illegible]rts from India to Germany [illegible] to be, the statistics do not [illegible]ly represent the total value [illegible] Indian produce which finds its way (in particular *via* Hamburg) to Germany, and is paid for and consumed in Germany. A considerable portion of such goods are still handled by London firms, being shipped from India to London "and—or Havre," "and—or Hamburg" ("and—or New York" even), and the owner or consignee disposes of them to the port which offers him the best price, receiving payment in time to meet the drafts drawn against them. The steamers bringing this Indian produce discharge, however in London, whence it reaches the consuming port—possibly Hamburg or Bremen—by some other vessel, the country whence these Indian goods are derived, when they reach Germany is then given in the statistical tables as the United Kingdom, Belgium, the Netherlands, etc,

Summing up the situation, Sir William Ward writes that, though German export trade to India has not up to the present reached any very great importance, particularly when compared with the export trade from the United Kingdom there can be no doubt that Germany, and more especially Hamburg and Bremen, are exerting themselves in many directions to extend their trade with India. "German firms already connected in business with India," he states, "have indeed lately begun to complain of increasing competition on the part of firms of their own country in this trade; and competent authorities have assured me that of late numerous German shipping houses, after finding that North and South America seemed to offer an insufficient field for their business operations, and that business with the Far East was too difficult, have turned their attention to India where they hope to find business more easy. How far these firms will be successful in their efforts is another question, for they will probably find it difficult to open business connections with the better class of firms

in India, in as much as these are not likely to give up their old established relations with European houses of good standing."

SOME MORE DETAILS INTERESTING AND SUGGESTIVE

Jute and cotton, it appears, are the two products which go furthest in swelling the volume and value of the Indian exports to Germany. The German Empire takes annually about one-fifth of the total exports of jute. Sir William Ramsay states that owing to the constant decrease in the demand for pure linen manufactures in Germany, cotton and jute and similar tissues have been steadily growing in request. As a consequence linen-weaving mills have found themselves compelled to take up the manufacture of half-linen, of cotton and half-jute tissues. Linen shirtings, towels, and the like are now almost entirely replaced in Germany by cotton and jute manufactures. "This," we read, "has been the case more particularly during the last two or three years, not only because prices favoured cotton and jute, but even more so, perhaps, on account of the improvements which have taken place in the general manufacture of cotton and jute goods." Another valuable trade is that in linseed and rapeseed, which is exported to the value of £2,000,000 yearly. These seeds are destined for the many oil mills established in the vicinity of Hamburg. India, of course, does a large business in hides, and Hamburg is the great distributing centre. About 40 per cent. of all the dry Indian hides exported in 1904 were destined for Germany, and their value exceed £1,000,000. The trade in shellac is also comparatively large, and wc much larger but for the fluctuations in price owing operations of speculator imports from Germany, a indicated, are much smal the exports to that country. At the same time they are by no means inconsiderable and they tend to increase at a rapid rate, particularly in the case of woollen, cotton, and silk textile goods. Indeed, it is asserted that German firms already in business in India have begun to complain of the competition of their own countrymen.

The German Consul-General at Calcutta remarks as follows: "The chief articles in which German exporters at present compete or ought to be able to compete with

other nations trading with India are, sugar, salt, butter, condensed milk, beer, wine, iron and steel goods, machinery, tools, cutlery, sine, aniline and alizarine dyes, chemicals, drugs, coloured, printed and dyed cotton piece-goods, hosiery, sewing yarn, woollen manufactures, glass, china and earthenware, musical instruments, paper and stationery, toys, umbrellas, scientific instruments, motor-cars and bicycles. Special attention, moreover, ought to be given by German exporters to Burmese markets, Burma being a very progressive and flourishing part of the [redacted] Indian Empire. One of the [redacted] difficulties for those who [redacted] to do business with India in [redacted] goods will be found to [redacted] in forming a correct judg-[redacted] regarding the financial position of an Indian customer, and the German exporter will not always be able to find efficient representatives in the principal commercial ports of India for undertaking the collection of the requisite information for him owing to the limited number of firms existing in those places who would be suitable for such purpose. In any case, however, German exporters should be very careful about giving credit to native firms which are unknown to them, and German commercial travellers should always bear this in mind.

GERMAN SCIENCE—THE ENEMY OF INDIA'S TRADE AND INDUSTRIES.

Unfortunately for India, most of the German Scientitic improvements of recent times have been the cause of ruining many of India's most lucrative branches of trade and thereby throwing millions of people out of employ, and closing many an avenue of earning livelihood—Dye stuffs—only a few years ago India used to export very large quantities of dyeing stuffs such as (1) Lac dye—value of which was as much as Rs. 80 per maund. (2) Saw flowers, which used to be exported largely and the price was at times as high as Rs. 120 but generally Rs. 20 to 30 per maund. (3) Bukom wood, out of which a fine red color used to be extracted and used to be largely exported and the value was Rs. 20 to 30 per maund. (4) Turmeric for yellow color, used to be exported as much as 150000 to 100000 bags every year but now the export has dwindled down as low as 5 to 6 thousands bags a year and it is feared that in a few years to come this trade also will vanish. (5) Indigo is doomed now and the shipment has greatly been curtailed and prices reduced which scarcely

leave any margin for the growers. Besides the above which were the most important there were several other smaller branches of trade on coloring stuffs which have been destroyed. Over and above, the loss of the great sugar industry in India is also directly due to Germany though there are other countries also who are shipping sugar to India. It was rumored (and reliable parties even now believe) that the German scientists have manufactured an imitation shellac which they can place in the market at about Rs. 30 per maund. It seems however that Germany will not be as successful in the imitation shellac trade as she has been in others, as shellac has been known to be sold as low as Rs. 13 per maund. and stick lac can be collected in the Jungles of Bengal, for the mere labor which is very cheap here. In jute we are afraid, our mills here may find very hard competitor in Germany as she is armed with state patronage. India has greatly to be afraid of Germany's inventive genius which is more or less directed against her.

JAVA'S TRADE.

UNDEVELOPED INTERNAL RESOURCES.

The latest published figures of Java trade show that among exports sugar stands first, the value of the amount annually exported being about £5,600,000. The annual export of coffee, the third on the list, is only about £200,000 less. Copra, tea and rice are the items of next importance. The recently established quinine industry is already in a flourishing condition. Though the natural resources of Java are largely agricultural, there are in the island undeveloped coal measures whose importance has not yet been determined, whilst the geological relations of the island to the Borneo-Sumatra oil fields suggests the possibili petroleum may yet be disc The trade of the island is carried on from the north and is shared between E Sumarang and Surabaya. last is the largest city of the three, though Batavia is the seat of the Government. A line of railway some 400 miles long connects the three cities. Branch lines and an extensive system of steam tramways operate for 700 miles through Central and Eastern Java, rendering all parts of the island accessible for freight and passengers.

THE INCREASE OF CIGARETTES.

INDIAN IMPORTS IN 1905.

The steady increase noted in recent years in the imports of

cigaretts of the cheaper kind was well maintained in 1905-06. The importation of this grade indeed continues to be the only progressive feature of the tobacco trade. Ten years ago the imported cigarette was almost unknown to the Indian population. To-day most of the traders in the article caters for their particular needs. In 1905-06 notwithstanding the boycott of the foreign cigarette, and the booming of the indigenous articles, the imports represeuted some 3,119,047 lbs. or about 1,40-0.000.000 cigarettes valued at Rs. [illegible]oo. The figures mark an [illegible]e of 23.8 per cent on the ex-[illegible]ally large total quantities of [illegible], and of no less than 167.6 per [illegible] the course of the six years [illegible] the article was first statistically distinguished. The United-Kingdom sent Rs. 28,25,000 ; the United States Rs. 11,40,000 ; Japan, the Straits Settlements and China Rs. 1,50,000, and the balance from Egypt. The last named represents the best quality and is the only class of cigarette in which a decline occurred. The average value per lb., it is interesting to note, was as follows:— Egyptian Rs. 6-4-3; British Re. 1-8; American Re. 1-1-6 and Eastern As. 13.

The total value of imported tobacco increased by 18 per cent to Rs. 66,00,000.

NOTA BENE INDIA'S IMPORTS AND EXPORTS

In the balance sheet of the foreign trade of India, the following figures are noticed, (for 1904-05):—

IMPORTS.

Cotton goods	£25365000
Metals	6232000
Sugar	4602000
Woolen goods	2051000
Hardwares	1597
Silk goods	1412
Glass	750
Dyes	618
Paper	429
Ry. material	2804000

Every one of these articles can be produced here out of our own raw material.

EXPORTS.

Cotton raw	11623000
Seeds	9605000
Jute	7977000
Hides and skin	6604000
Lace	2051000
Wool	1261000
Coal	310000

If these articles had been turned into manufactured products before export, the value might have been doubled.

CHINA'S BOYCOTT OF AMERICA.

The success of the Chinese boycott against American goods has

been extraordinary. It is calculated that the value of merchandise from the United States in stock at Shanghai is four millions sterling, and as there is no outlet in Manchuria as distinct from China any immediate clearance seems out of the question. A combination, of twenty-three of the big Chinese firms have bound themselves under heavy penalties to continue the boycott and they are powerful enough to hold their own. Everything seems to be done in the quietest and most methodical way, and the exclusion of American goods is carried out most effectively. The Chinese guilds have doubtless helped the merchants concerned and there seems no present chance of any change taking place in the abnormal conditions which have been established. Other countries are interested in the matter, for what the Chinese have done to-day as regards America they may attempt in the future against Germany, Russia, and even England. They are erecting cotton mills and other factories, opening coal-mines, and accelerating the construction of railways. When the industrial era begins in earnest China will curtail her imports and endeavour to become self-supporting in respect of the goods which she now takes so freely from foreign countries.

SHIPPING MERCHANDISE TO FOREIGN COUNTRIES: TABLE OF FREIGHT (FROM CALCUTTA HARBOUR) STEAMER VIA CANAL

FOR LONDON.

	Per Ton.		
Saltpetre	£0	15	0
Rice & Wheat	£0	17	6
Peas	£0	17	6
Linseed	£1	0	0
Rapeseed	£		
Poppyseed	£		
Jute & Cotton	£		
Gunnies...	£		
Hides	£		
Tea	£		

FOR DUNDEE.

Jute ... ...Nom

MEDITERRANEAN PORTS.

(VIA CANAL.)

Jute and Cotton ...	£1	3	9
Light Freight	£1	2	0
Linseed	£1	3	9

MAURITIUS.

Grain per bag by Steamer Re.1 1 0

ADEN AND JEDDAH

BY STEAMER.

Rice per bag Re.1 2 0

FOR LIVERPOOL

	Per Ton.		
Saltpetre	£0	15	0
Rice & Wheat	£0	17	6
Peas	£0	17	6

Linseed	£1	0	0
Rape & poppy seed Nominal			
Jute & Cotton	£1	0	0
Gunnies...	£1	5	0
Hides	£2	0	0
Tea	£1	10	0

FOR NEW YORK.

Saltpetre via Canal ...	$4½
Jute	$5
Gunnies	$5½

HAMBURG.

(VIA CANAL)

	Per Ton.		
Rice & Wheat	£0	18	9
Jute & Cotton	£1	1	3
Linseed	£1	1	3
Hides	£2	2	6
Light Seeds	£1	6	3

AUSTRALIAN PORTS

BY STEAMER.

[illegible]	£0	18	0
[illegible]nies...	£0	12	6
[illegible]	£1	2	9

N. B. Unlike Railway freights, which to all intents and purposes are steady and fixed, these shipping rates are liable to frequent fluctuations for a variety of causes, paucity of steamers and so on—the risk of which can be avoided by securing what are called 'forward frieghts' like 'forward contracts' in piece goods &c.

MOFFUSIL MERCHANTS.

Being far from the metropolis the moffasil merchants are not in touch with the Calcutta Produce Market and hence they are always in the dark regarding the existing rates and future prospects of any article of country produce. This always leads to loss or less profit which can be easily prevented. To remove this want, an **Intelligence Branch** has been opened to supply the following necessary information to the moffasil merchants, *viz* :—

(1) To supply market rates.

(2) To give advice as to the best time to buy or sell any article.

(3) To negotiate sale or purchase for any article at Calcutta.

(4) To receive consignments.

(5) And to advance money on any article of Country Produce. Scales of charges as under.

	Rs. A. P.
For supplying all the necessary information regarding rate, future prospects and tendency of the market for any one article of Country Produce per month, once a week. ...	1 0 0
For supplying the above information every second day regularly, for any one article	2 0 0 per month.
Ditto for more than one article not exceeding seven	4 0 0 per month.
For supplying any other information	1 0 0 each time.

All the charges payable in advance.

HINTS TO MINING ENTERPRISERS.

MESSRS. B. BOROOAH & Co., 3, Hare Street, Calcutta, having secured the services of several Mining Experts, under whose Management their various properties in Bengal, the Central Provinces and Bombay are now being worked, will be glad to undertake prospecting in any part of India on behalf of any person or Syndicate. They are also prepared to accept Agencies of going concerns or to work out any concession on very liberal terms, which may be ascertained on application. They will also be glad to receive and furnish any information relating to the Mining Industry in India. The Firm possesses corespondents in England and on the continent.

A SILK AGENT IN ENGLAND.

For the benefit of our Swadeshi silk merchants we might mention that Messrs. Durant Bevan & Co. of 9 New Broad Street, London, E.C., are perhaps the most reliable home agents for Indian silks. Their brokerage charge is 1%.

EXPERT ADVICE IN INDUSTRIAL MATTERS, MR. CHATTERTON'S OBSERVATION.

"I wish to draw your attention to another serious difficulty under which you labour in this country in regard to industrial matters and that is this, that you are practically unable to obtain disinterested advice. The private Consulting Engineer does not exist in India, and if you apply to a firm imports or manufactures machi it is, I am afraid, but natural they should try to sell you they themselves deal in rather advice you to go to some body who might better supply your w Then, again, when such machinery has been installed the want of some one to inspect it from time to time, to tell you what to do to keep it in good order, has been a source of many failures. In time it is to be hoped that there will be plenty of men trained in India to do this work. But just now there are none and it seems to me possible that Government might render a good deal of assistance in the industrial development of the country if they were to allow the general public to make use of the services of their expert officers for the advancement of private enterprise."

It has been in contemplation since some time ago, to start a Control Bureau of Commercial and Industrial Intelligence in Calcutta. The suggestion of Mr. Chatterton deserves consideration at the hands of the promoters of the said Bureau.

WHERE TO GET YOUR MACHINERY.

Needle-making Machinery—Apply to Messrs, F. B. Shuster Co. Haven Conn, U. S. A. or H. arr, Worcester Mass U. S. A.

in making Machinery—Write essrs F B Shuster Co. New en Conn, U. S. A. for estimates &c.

Cigar and Cigarette making Machinery—The Miller, Du Brul and Peters, Manfg. Co. Cincinnati, Ohio U. S. A.

Confectionery of various kinds. Write to The Confectioner's Machiner and Manufacturing Co Springfield Mass: U S A.

Wind Mills—Can be applied to various Industrial purposes, such as grinding corn, pumping water, &c, and can be had from Baker Mfg Co, Evansvile, Wis U. S. A.

Tin can maker's Machinery will be supplied by the Crossley Manufacturing Co Trenton, N. J. U. S. A.

For Sand Paper making Machines. Apply to the Berlin Machine works, Beloit, Wis, U S A.

Machinery for Printing Textiles to John Waldorn Co New Brunswick, N. J. U. S A.

Photo engravers Machinery to John Royle and Sons Peterson, N. J. U. S. A.,

Paper box-making Machinery, For estimates and other particulars write to Chas. Beck Paper Co. Ld Philadelphia Pa U. S. A.

For Paintaing Machines to the water Paint Co of America New York, U S A.

Oil refining Apparatus Can be had from "Baker Iron Works,' Los Angles, Cal U. S. A.

Envelope-making Machinery—John Lloyd Co New York, U S A

SUGARCANE MILLS.

Mr. A. E. Jordan's cane-crushing and juice boiling plant may be given a trial by those interested in the sugar industry. It is more highly spoken of than Messrs Jessop and Company's machine. Sir. D. M. Hamilton of Messrs Mackinnon, Mackenzie and Company, who has interested himself in Mr. Jordan's machine will, I am sure, give information to any member seeking any information on the subject.

MACHINERY, TOOLS, IMPLEMENTS. THE "SIBPUR" PLOUGH

The "Sibpur" plough and several other mechanical appliances are in daily use at the Sibpur Government farm and have proved quite suitable for the various purposes concerned.

The Director of Land Records and Agriculture, Bengal, may be addressed by any one wishing to know about them.

PLOUGH, BELLARY PATTERN

An experiment is being tried at Koilpatti with the cotton soil plough in black soil. In Bellary a large plough drawn by several yoke of cattle is usefully employed, and this is now being tried by Mr. C. Benson, the Deputy Director of Agriculture at Koilpatti. The Zemindar of Ettiyapuram and certain of the ryots visited the Kolipatti farm and watched the experiment of breaking up waste land infested with hariali and other grasses. The Zemindar and his ryots were convinced of the utility of the implement from the standpoint of efficiency of work and cheapness of the cost of labour in reclaiming waste lands affected with deep-rooted weeds. The Zemindar, we are informed, has decided to invest in a number of these ploughs for his own estate.

GARDEN PLOUGHS

Garden ploughs made in imitation of the junior planet hoe of Messrs. Allen Brothers of America were exhibited at the Benaras exhibition of 1905. These ploughs can be worked by a man, a bullock or a pair of them and are priced from Rs. 22. They are useful for garden purpose. They may be had from Professor Bose and Co. Tollygunge Road, Calcutta.

WATER PUMPS, AND S MACHINERY.

The Cawnpore Experimental Farm of the U. P. of Agra and Oudh Government exhibited excellent water pumps priced at Rs. 40 as also machinery for making sugar by Messrs. Broodlunt and Sons, priced Rs. 400.

REAPING MACHINES IN THE PUNJAB.

In the Punjab the authorities propose to try the experiment of importing a certain number of reaping machines from England for hire to colonists on the great Punjab canal colonies. A couple of these machines have already been

placed on the Sargodha and Lyallpur Farms and a third is being imported by a large grantee on the Chenab Colony. The machine which is being tried in the Punjab is said to work well and to cut at the rate of an acre in 40 minutes. The Punjabi cultivator is keen to adopt western methods in his agriculture if it can be proved to him that it will pay to do so, and if the reaping machines will save him time and labour they will no doubt be taken up by the cultivators. At any rate experiment of importation machines seems worth and the Punjab initiative be noted in other Pro-

PADDY HUSKER BURN AND CO'S.

(*a*) This company of Engineers have after many trials and experiments brought out this Husker, which, we believe, will be welcomed by a great number of people in this and other provinces. It is easy to work, one bullock being sufficient to drive it, and will husk from one to one and a half maund of boiled and dried paddy in an hour. Two men can also work this husker and the quantity of broken rice in what it husks is remarkably small. All are welcome to see it running in the Company's Howrah Iron Works.

(*b*) *Patentee*—Babu Rakhaldas Khan, 48 Golabari Road, Sulkea, Howrah.

All processes from the boiling and drying of the unhusked paddy to winnowing and husking are done by the same machinery. The parts are all of iron and steel. The machine can be worked by hand or engine.

(*c*) A specially mentionable husker was exhibited at the Mymensingh Saraswat Exhibition, 1905 by R. J. D. Santi.

(*d*) At the Suri (Birhum) agricultural show in February 1906 a new pattern of husking machine was exhibited which produces 2½ maunds of husked rice daily in 6 hours time.

KNITTING MACHINES

(1) THE VICTORIA AUTOMATIC KNITTER.

A SEAMLESS RIBBED HOSIERY MACHINE.

THE NEW FOSTER KNITTER

Knitting all kinds of articles for which its width is suited.

Producing 2 Guernseys, or 2 pairs of Socks or Stockings per hour.

PRICES OF HAND MACHINES.

Circular Machine (for Socks and Stockings) ...	Rs. 130 to Rs. 172
Flat-bed Do. (for Socks, Stocking and Guernseys &c.) ...	Rs. 150 to Rs. 200

PRICES VARY ACCORDING TO SIZE AND FINENESS.

Instruction free to purchasers at Calcutta.

Sole Agent :—

N. K. MAZUMDAR,

21-1 Musalmanpara Lane,

Calcutta.

(2)			Price		
48-needle	...	...	130	0	0
60 „	...	...	135	0	0
72 „	...	...	140	0	0
84 „	...	...	145	0	0
96 „	...	...	150	0	0
108 „	...	...	157	0	0
120 „	...	...	162	0	0

The 120 needle machine will knit very fine socks and banians.

Messrs. K. M. Dey.
45 Radhabazar,
Calcutta.

Lessons free to buyers in Calcutta.

Sialkot Cutlery.—The firm of Messrs Shib Das Sing Uberoi and Co., proprietors of the Punjab Iron Works, Sialkot, is by this time too well-known not only in the Punjab, but outside that province to need any recommendation at our hands. The Company confined their attention previously to the manufacture of surgical instruments of a type which gave great satisfaction to the profession on account of their finish reliability and cheapness. Now they have taken to cutlery also and have sent us a two bladed knife, excellently polished and grounded, and made of steel, scientifically and methodically tempered, so as to compare favourably with the best products of Sheffield. We have every confidence that Messrs. Shibdas Sing Uberoi and Co., will score as great a success in this line of business as they have in their older branches of activity.

NIB-MAKING MACHINE.

Gopal Chunder Karmakar of of Patuakhali in the District of Barisal has devised a machine for making nibs, which can make [illegible] nibs per day.

LIFT IRRIGATIO[N]

Mr. Alfred Chatterton [illegible] Madras Engineering Colle[ge] has devoted considerable a[ttention] to the subject, has published a number of essays bearing on lift irrigation in the form of a book (Messrs. G. A. Nateson and Co., Madras). In these essays he deals exhaustively, and from the standpoint of the practical agriculturist, with the question of irrigation by means of oil engines and wind mills, As regards oil engines, Mr. Chatterton gives it as the result of his comparison of several experiments that under favourable conditions with cattle 4,000 cubic feet of water can be lifted 1 foot for one anna ; and with small oil engines he thinks that under similar conditions at least double [illegible]

amount of work can be done for the same money. When it is possible to install a big pumping plant, the working expenses are, of course, very much less and amount to from $\frac{1}{6}$-$\frac{1}{8}$ to that which would be incurred if cattle were employed. The cost of purchasing an engine may be prohibitive in some cases, but there is no reason why "takavi" advances should not be made for this object as well as for the purchase of cattle. The oil engine, is an economic means of well-irrigation, and has clearly a great future before it in this country. ...lls are other expedients ...ve been suggested for the ...urpose. These depend for ...ficiency on various local ...s. But Mr. Chatterton is of opinion that along the sea-coast from Karachi to Bombay and from Diamond Harbour to Negapatam, over a large tract of the Deccan, over the Mysore plateau, and probably in most of the hill stations, windmills will be found to be, if not ideal machines for lifting water, but by far the cheapest and most convenient of mechanical appliances available.

GOVERNMENT IRRIGATION EXPERIMENTS IN BENGAL (1905).

It has been decided to abandon the experiments, undertaken on the lines indicated by the Irrigation Commission, especially with regard to economy in the use of water, until it is possible to carry them on a larger scale, and at more suitable sites, where an officer of some standing can supervise the work.

Last year, Mr. N. N. Banerji was placed on special duty in connection with well-irrigation. He visited the United Provinces, and made himself acquainted with the practice of irrigation from temporary wells, which have proved in famine years so valuable a resource in the eastern districts of those provinces; he then toured round the districts of the Patna, Bhagalpur, and Chota Nagpur Divisions in order to ascertain whether there are any insurmountable obstacles to the extension to those districts of the methods of well-irrigation which prevail in the United Provinces and to indicate localities in which the sinking of wells may be beneficial. He has completed his tour, and the report of the results of his enquiries is awaited. He has meanwhile, submitted proposals regarding the training and maintenance of an expert well-boring staff whose services could be lent to landlords and cultivators. These proposals are now under consideration of the Government.

HOW TO IDENTIFY A DIAMOND.

Prick a needle hole through a card, and look at it through the doubtful stone. If the stone is spurious, two holes will be seen on the card; if it is a diamond, only one hole will be visible, for every other stone at all resembling the diamond gives a double refraction. This method is also made use of for determining an uncertain stone. If the finger is placed behind it, and looked at through the stone with a magnifier, the grain of the skin will be plainly visible if the stone is not a diamond, but otherwise it will not be distinguishable at all. A diamond in a solid setting may be identified in the same way; if genuine, the setting at the back cannot be distinguished, but if a false stone, either the foil or the setting may be plainly seen.

A NEW METAL ALLOY.

A new metal alloy has been discovered by a wandering Russian tinker, named Lishnymoff, which bids fair to play an important part in art and manufacture. It resembles aluminium in lightness, but vastly excels it in durability. Lishnymoff who discovered the alloy casually refuses to reveal its constituents.

SCIENTIFIC WARFARE AGAINST CLOUDS AND SAFE-GUARD OF CROPS.

It has become almost a commonplace occurence to shoot at the clouds with cannon or specially constructed apparatus to dispel threatened hailstorms. In almost every country on the C where agriculture forms th stay of the people, there tematic use of these storm ers. In many parts of Fran Germany, and Austria, the has grown so extensively that it often forms part of an official department of the municipality. In such cases, with the assistance of the neighbouring land-owners and farmers, thorough systems have been devised, till the elements have become so harnessed that it is almost impossible for them to inflict any injury on the crops. Cloud shooting has now here become more generally used than in the vicinity of Venice, in Lombardy and Piedmont. Herr Stiger, the originator of the present method, gives some interesting facts regarding his experiments with the cloud shooting

cannon. He began his experiments with the fundamental principle of disturbing the intense stillness which prevails before a hailstorm. In view of the established fact that there is no physical reason why sound waves should exercise an effect, on the formation of hail, Stiger determined that it would be necessary to confine his operations to creating the form of a whirlwind. An official trial demonstrated the fact that after the firing of a shot a small whirlwind arises, easily perceptible in the reflected sunshine.

MIC WORK IN THE L BOTANICAL GARS CALCUTTA. 1905-5. SOME INSTRUCTIVE INFORMATION.

'Sunn' hemp (Crotalaria juncea)—seed of which was obtained from all parts of India where it is grown—was again cultivated in small plots. It was thought that by sowing fairly late towards the end of October, better results than those of last year might be obtained. As it turned out the result was the reverse of what was expected. Almost all the plants began to flower when little more than a foot high, and they obstinately declined to grow much higher. On two occasions every plot was flattened out by heavy rain, which did not tend to improve matters. As far as yield of fibre is concerned, no results which could be relied upon could be obtained from plants which behaved in such a manner. As the cultivation of 'Sunn' hemp is likely to prove of very considerable importance to India, it is proposed to continue plot-experiments until some definite results are obtained, or until the Agricultural Department can take up the experimental cultivation on a larger and more satisfactory scale than is possible on the very limited amount of ground available in the garden.

In India there has been a revival of interest in rubber, and not a few applicants have been furnished with information and seed or plants of "Ficus elastica" and Manihot Glaziovii." The latter, which yields Ceara rubber, appears to thrive in Bengal and Assam, doubtful whether it yields rubber equal to that obtained from the same species cultivated in Southern India and Ceylon. Camphor-seed has been supplied to certain parties. Sisal hemp plants have been distributed to certain jails, and lime-seeds as usual to many of the jails in Bengal. Seeds of timber and other useful trees have been largely distributed over India and to other tropical or semi-tropical countries.

ECONOMIC VALUE OF COTTON-SEED

The seed which is separated from the cotton fibre is now an important article of commerce. Of the total yield of cotton in seed, the proportion of seed is, in weight, about 65 per cent. In 1904-05, nearly 400,000 tons were exported from Alexandria to various markets, the principal being Hull, which took over one half of the total quantity. As with cotton, so with seed, the Continent is becoming an important factor, owing to the expansion of the crushing industry. As is well known, a valuable oil is extracted from the seed, and from the residue are manufactured cakes, which contain excellent properties for feeding cattle and sheep. The crude oil is refined, and in its refined condition is used for various purposes. Soap-making is one of its most important functions. A more thorough process of refining makes it suitable for edible purposes, and in that form it is largely used on the Continent. Probably it would be difficult to enumerate all the articles into the composition of which it frequently enters. But the reader may guess, without in many cases being far wrong, that the soap in his bath-room, the cooking butter in his kitchen, and the olive oil on his table, all have more or less a common derivation, partially or wholly ; and that derivation is the seed of the cotton plant.

(*Vide p. 250, ante.*)

PAPER IN BURMA.

The Report on the manufacture of paper-pulp in Burma which has been submitted to the Government of India by Mr. W. Sindall, F. C. S., is full of important and interesting information which should prove of great value to all who are interested in the paper-industry in India. It cannot be said in recent times the out-loo[k] the paper-industry in this co[untry] has been quite as cheerful [as it] used to be, and when some [time] ago, we referred to the inve[stiga]tions of Mr. Sindall in Burma at the instance of the Government of India, and we stated that Mr. Sindall took a very hopeful view of the future of the paper industry in Burma. We observed in that connection : "If an expert of the standing of Mr. Sindall can express himself with confidence as regards the future of a paper industry in Burma, it ought certainly to be worth while to make a thorough investigation of the question so far as concerns Indian areas which from more than superficial observation, are apparently suited for the establishment of the paper-making business on a commercial scale. The full text of

Mr. Sindall's report entirely bears out our view in the matter. The enormous quantity of raw material available in this country as a source of supply, has always possessed attractions for the Government of India, and investigations and inquiries into the possibilities of paper-making have been instituted from time to time by the Government with a view to place the industry on a stable and steady basis in India. As far back as 1873, the Government took steps to collect information ... ports were issued on the ... state of the industry. ... the report of Babu Hem ...a Ker in 1874 and the ...andum by Mr. Liotard ... contain much useful information on the matter. There were also other pamphlets on the subject published from time to time, but the most modern publication on the subject is the "Report on Indian Fibres and Fibrous substances" published by Messrs. Cross, Beven and King in 1887, which is a valuable monograph based on the fibres exhibited at the Colonial and Indian exhibition of 1886. The principal fibrous materials this pamphlet refers to are the plantain, the Munj and Bhabar grasses, the Bamboo and the Papermulberry. Mr. Sindall gives what appears to us an excellent reason why this subject has not received further attention and why paper-industry has not been viewed with great favour. "The broad general statements, in most of the reports that 'the cost of collecting raw material and getting it to a mill is 'prohibitive' or statements of a similar kind, have stopped further investigation. But when the list of those fibres which, by common consent, gives excellent paper-pulp, is examined and cut down to practical limits, *i. e*, abridged until it only contains fibres known to be fairly plentiful, the whole subject is reduced to such a compass as to render a proper investigation of 'commercial conditions feasible." This explains why this question remained in a practically neglected state until Mr. Sindall, who is well known as a consulting chemist and a wood-pulp and paper trade expert, was deputed in 1905, to investigate in Burma the possibility of utilising wood, bamboo and other fibres as raw material for paper making and to determine whether the process of pulp or paper manufacture could be carried out successfully.

Mr. Sindall's investigation extended over a period of four months. In the first place, he has carried out experimental work on certain varieties of wood and bamboo, as to the kind of paper-pulp that could be obtained. In the second place, he has also inspected certain

mill sites. Thirdly, he has investigated the actual cost of production of the paper-pulp and other information regarding the commercial aspects of the industry. The report before us not only gives details of the scientific experiments made by Mr. Sindall in converting wood and grass into bleached and unbleached pulp, but also information as to the cost of the raw material, the cost of the manufacture of the pulp into paper in mills in suitable localities. It is not possible to go into these details here, but we may draw attention to the net results which he has reached by his investigations. He considers that even at the approximate costs of the bamboo now ascertained by him the manufacture of paper-pulp for export is a practical commercial problem, and that the prospects of an export trade for unbleached bamboo pulp would appear to be reasonable, having regard to the excellent quality of pulp prepared from favourable conditions. The manufacture of bleached bamboo pulp for export does not seem to him a feasible proposition, 'since bleaching powder brought out from England to such a warm climate suffers considerably in strength and quality.' The bleaching of such pulp could be affected much cheaper by the paper-maker here, and he therefore thinks that "the value of the pulp for local use in a mill in Burma itself is undoubted and the manufacture of paper from bamboo as a new industry for Burma is an attractive proposition, especially in view of the large demand for paper and similar products in the populous towns." As regards other wood species for manufacturing wood-pulp, Mr. Sindall's calculations go to show that the cost of the manufacture and the prices prevalent, do not seem to warrant the idea of opening up any large export trade in wood-pulp. On the other hand, he thinks that if the pulp is utilised at a mill in Burma for the manufacture of paper for local tion, 'it can be produce which would be very tive.' The question of lishment of paper mills would thus appear to be one of immediate practical importance, and the encouragement will induce many Indian businessmen to turn their attention to an industry which has not yet been exploited by European capital in Burma.—The *Hindu*.

(*vide P. 270, ante.*)

TRIAL CULTIVATION OF COMMERCIAL PLANTS IN ASSAM.

Among promising commercial plants, under cultavation at the Government Tropical Plantation at Wahjain in the Khasi Hills in

Assam are: Cocoa, cardamom, camphor, coffee, lemon grass and Rusa grass. The plantation which was opended in January 1904 was established for the purpose of introduction into the Province certain of the tropical products of Ceylon and Madras for which it is believed climatic and other conditions are favourable in Assam. The plantation is still too young to justify any definite conclusions from the experiments so far in progress, but according to the official report there is evidence that some of these are quite promising and another couple of years' trial ought to de- [illegible] which are the products [illegible] will pay to grow."

-INFLAMMABLE CELLULOID.

The material known as celluloid, has been brought largely into use of recent years for the manufacture, at a cheap rate, of many articles previously made from much more costly materials, such as hair-combs, knife-handles, and toys (the familiar "pingpong" ball being a well-known example). It has many advantages besides cheapness; it is very light, possesses a good natural appearance, and can easily be coloured in such ways as to make it closely resemble such costly materials as tortoiseshell. But it has one drawback, and that a very serious one; it is highly inflammable, and therefore dangerous—not very surprising when we remember that its nearest chemical ally is gun-cotton. Recently, however, a modification—curiously described as a new kind of celluloid—has been patented, which appears to be free from the dangers attending the use of ordinary celluloid. The latter substance. when in the liquid state is mixed with certain proportions of glue, gum arabic, and colza oil; the mixture is then put through a series of processes, in the course of which it deposits all cloudy sediments, finally emerging as a clear, white substance just like ordinary cellulose, and capable of being worked up into the same description of articles, imitation tortoiseshell among the number. It is not asserted that the new substance cannot be set on fire; what is claimed for it is that fire will only cause it to chair, without blazing or melting, as its prototype does. If this claim be sustained, the new material is practically harmless, being just as much safer than the old as woollen clothing is safer than flannelette.

SALT-WATER FISH IN FRESH WATER.

An interesting experiment that should have far-reaching results has just been brought to a success-

ul issue in Germany. It has been proved that deep-sea fish can be acclimatised in fresh water, and will live and breed in our rivers. A number of different kinds of fish were taken from the sea, including whiting, herring, sole, and flounders, and kept in a pond of salt water. The percentage of salt was gradually lessened by the addition of fresh water until finally no salt remained. Practically no material difference took place in the fish, which were as lively and healthy after the treatment as when taken out of the sea. So encouraging has been the result, after a test extending over several months, that the fish are now being introduced into the various rivers and fresh-water lakes, in order to bring the experiment to a practical issue. What changes may take place in the nature and habits of the fish remain as yet to be seen, as does also the question of their market value. The success of this experiment will entirely change the fishing industry, and will prove an especial boon to communities far removed from the seaboard. It will enable them to have a constant supply of fish in their own waterways, which they will be able to buy at an infinitely smaller cost than at present.

MIRZAPUR QUARRIES.

The stone quarries in Mirzapur, United Provinces, which form a Government property under the management of the Collector of the district, were worked in the year ending the 31st March, 1906, at a net profit of Rs. 21,441. The income derived chiefly from the duty levied on the stone exported, amounted to Rs. 84,037. Out of a total expenditure of Rs. 62,569 the sum of Rs. 47,988 was devoted towards the improvement and upkeep of the means of communication between the quarries and the railway. The chief productions of the quarries are stones for sugar mills, hand mills and for domestic purposes; building stones, ballast and stones for ceremonial purposes. The demand is brisk and has developed well duri years. It suffered slight last year, however, thi unprecedented lowness of Ganges, which rendered export by boat difficult, and from occasional shortage of railway waggon.—"Indian Trade Journal."

(*vide Part II, ante*)

SLATE QUARRYING.

The slate-quarrying industry which is mainly confined to the Punjab and the United Provinces, produced during the year 1905, 74,527 tons of slate of the value of £5,550. Of the total production the Punjab share is as much as 62,989 tons and the United provinces share 11,300 tons, the small

balance representing the outturn in Bengal and Rajputana.

(vide p. 156 ante.)

MINERALS IN NATIVE STATES.

OFFICIAL REVIEW.

Of minerals being worked in Native States in India the official report on mineral production in the country in 1905 gives the following particulars: Cornelian stone is being mined for in the Rajpipla State in Bombay, where 467 tons of the value of £466 were obtained last year. Corundum min- [illegible] yderabad produced mate- [illegible] e value of only £39, while [illegible] lkhand in Central India [illegible] were extracted. In the [illegible] State in Rajputana the production of gypsum was 4,810 tons of the value of £160 as against 3,875 tons raised in 1904 of the value of £129. Garnet mining is also carried on in several parts of Rajputana, where the output last year was about 700 cwts., averaging about £6 a cwt. in value. The centre of the industry in Rajputana is in the State of Kishengarh where a large quantity is mined annually and where the mines are open to the public for the first three and last three months of the year, and for the rest of the time are worked by the State which employs from 200 to 600 people daily. The revenue derived from the industry is about Rs. 70,000 annually.

(vide Part II, ante)

SAPPHIRE IN KASHMERE.

Sapphire mining which has once more been started in Kashmir is expected to turn out well. It may not be generally known that these mines are at an elevation of 10,000 feet above sea-level, and are thus by far the highest mines, so far discovered in the world.

COMMERCIAL USES OF SAWDUST.

Imitation marble can be manufactured from a mixture of sawdust, ivory waste, glass, and glue.

There must be a great deal of saw dust made in Calcutta and wherever there are saw mills in operation. What is done with it? The Japs are extracting acetic acid, wood naphtha, tar, and alcohol from their saw dust. Could not our chemical experts do the same, in Bengal? They could, if they like to tackle the enterprise.

NITRIC ACID AS A BY-PRODUCT OF THE GAS-ENGINE.

The internal-combustion engine is coming so rapidly into favour as a cheap power-producer for almost every kind of work that

o look for a further means of heapening it would seem almost upererogatory. However, an ttempt has been made, and apparently with success, to utilise ven the waste gases of the xhaust in the making of a valuble by-product. The subject has een brought forward by Herr Hauser in a lecture before a branch of the Society of German Engineers. It appears from his address that, by means of a very simple attachment, any ordinary gas-engine may be made to produce nitric acid with no very serious diminution of power. It s probable that there will be always a ready market for nitric acid in almost any quantity : but it may perhaps be questioned whether the amount of acid evolved as a bye-product from the gas engine will have sufficient commercial value to make the extra trouble worth the taking. In any case, however, the attempt is an interesting one, and its application will be keenly watched by all users of internal combustion engines.

STORAGE OF COAL UNDER WATER.

On all railway lines in India, and in the seaport towns also, are seen vast stacks of coal exposed to the action of the weather; and the wastage due to the great heat and high winds must be considerable. Some years ago the Bombay Chamber of Commerce investigated the subject of storing coal under water but, so far as we know, nothing very material resulted. The ' Indian Trade Journal" now draws attention to the matter and shows what is being done in America. The Chicago Electric Company have adopted the system and have built pits capable of holding 14 000 tons of coal. These can be rapidly flooded and the reserve of coal can thus be kept protected from all weather influences. The saving effected is supposed to be considerable, there is no deterioration of coal itself. Experiments r well be carried out in Indi also at some of the great co stations on ocean routes, whe... water is easily obtainable. Perhaps some of the mills in Calcutta, Bombay or Cawnpore, suggests the "Pioneer," will be enterprising enough to try storage on a small scale with a view to seeing whether economy is really effected. They could then have their reserves of coal and be saved from the danger of short supplies of fuel when the railways are congested with traffic.

THE NIZAM'S SCHOLARSHIPS.

In place of the hitherto nondescript fashion in which scholarships

have been granted to students desirous of prosecuting their studies in Europe or America, His Highness has ordered the publication in the "Jerida" of rules under which scholarships will in future be granted. There will be eight scholarships styled the Nizam's Scholarships two of which will be assigned to students wishing to study in Europe or America, the value of which will be £200 per annum, tenable for a period not less than three and not more than five years. The remaining six will be assigned to students desirous [illegible]secuting their studies in India or Japan. The scho[illegible] assigned to students study[illegible] British India will be Rs. 50 [illegible]r mensem, tenable for three years, and those assigned to students studying in Japan will be Rs. 100 each per mensem, also tenable for three years. Students proceeding to Europe, America or Japan will be granted Rs. 500 for outfit and carriage of luggage plus the exact cost of second-class fare by steamer and rail from Hyderabad to the place of destination. The candidates must be conversant with Urdu and should have passed the F. A. or Intermediate examinations. They should not be above 23 years of age and must be natives of H. H. the Nizam's Dominions, whose father or grandfather served the Government for not less than 12 years. Due notice will be given in the "Jerida" and newspapers when candidates will be invited to apply.

(*Vide Part VII, pp. 1-4, sq.*)

PART VII.

Technical Education in India and abroad.

ASSOCIATION FOR THE ADVANCEMENT OF SCIENTIFIC AND INDUSTRIAL EDUCATION OF INDIANS.

The object and scope of the Association which owes its origin to the Hon'ble Mr. Jogendra Chunder Ghose (the Hony. Secretary) and the noble work it has been engaged upon these two years mainly through his untiring personal exertions are already too well-known to the country to need any recapitulation here.

A sufficiently detailed account of the rules and regulations, funds raised and expended, the various collateral schemes such as Deoghur Agricultural Colony, National Bank, Development of Small Industries, &c., which the Association is promoting in the interests of our countrymen—will be found in the Printed Reports and Prospectuses issued by the Association from time to time.

For convenience of reference, however, a list of the scholars sent abroad, and the subjects taken up by them and the countries where they are being trained, is appended to this part.

STATE TECHNICAL SCHOLARSHIPS FOR NATIVES OF INDIA.

1. With a view to provide for natives of India the higher technical education which may qualify them to assist in promoting the improvement of existing native industries, and the development of new industries, wherever this may be possible, the Government of India are ready, as an experimental measure, to give a small number of Technical Scholarships, if promising candidates, well qualified in some particular branch of industry, present themselves. The outlines of the scheme are sketched out below:—

2. *Value of the Scholarships.*—The value of the scholarships has been fixed at £150 a year, in addition to fees payable to the institutions where scholars will study, and travelling expenses, but Government will consider proposals for increasing it in special cases.

3. *Place and Periods of Tenure.*—Each scholarship is tenable for an average period of two years, which may be increased or reduced in special cases.

4. The scholarships may be held in Great Britain, in the Continent of Europe, or in America, and are payable from the date of the scholar's arrival in the country which he may select for study.

5. *Subjects of Study.*—Law, Medicine, Veterinary Science, Agriculture and Engineering have been excluded from the scope of the present proposal. The scholarships are in the first instance proposed to be used for the encouragement of the mining industry in Bengal but any other branch of ry can similarly be helped stered. Industries in which capital and enterprise are ed, or likely to be engaged, which the trained scholar might, on return to his country, find scope for his skill and ability, will be particularly appropriate for selection.

6. *Conditions of Award.*—The scholarships are tenable by persons who are natives of India within the meaning of section 6 of the Statute, 33 Vic. Cap. 3. A competent knowledge of English, or the language of any other country in which the candidate proposes to work and study, is essential to enable him to take full advantage of the course of study.

7. In the matter of selection of scholars, Government will be guided by considerations of the candidate's capacity, intelligence, particular interest in and connection with the industry selected, and the assurance that he will continue to devote himself to the subject on his return to India. These being matters which cannot be decided by the holding of degrees obtained by examination, or by competition, no special examination is considered necessary and none will be held. But a scholar before nomination should have received the best technical education available in the Province in the particular industry which he has to study and no candidate will be considered qualified unless he has displayed an aptitude for technical study.

8. No age limit has been fixed. But it may be fixed by Government in certain cases.

9. The candidates for scholarships will be called upon to submit certificates attesting (*a*) their moral character, (*b*) knowledge of the language of the country in which they elect to study. and (*c*) physical capacity, from recognized persons who may be considered fit to certify to these facts.

10. The scholars in England or elsewhere, as the case may be, will be under the control and supervision of the Secretary of State. The conditions under which they will hold the scholarships will be similar to those laid down for Government of India scholarships, and power will be retained to cancel a scholarship and to send

the scholar back to India if his progress and conduct be not satisfactory.

11. *Returned Scholars.*—No scholar will be bound on his return to India by any engagement to serve Government or a private firm, and the choice of his career will be in the first instance determined, on his return from Europe by his own inclination. Should any occasion arise, Government will be glad to turn his ability and increased knowledge to account, as teacher in an Industrial School or in other capacities connected with the improvement of local industries.

12. Applications for one or more of such scholarships, for the development of the mining industry in the first instance, should be made direct to the Director of Public Instruction. Full particulars should be furnished as to the past educational experience, training and future requirements of each applicant for scholarship. Applicants should also indicate, if possible, what they wish to work at in their future careers on return to India. The scholarships will be awarded by the Government of India on the recommendation of the Local Government.

13. Written applications from candidates for the scholarships mentioned in Rule 12 for the year 1904 will be received at the office of the Director of Public Instruction, Writers' Buildings, Calcutta, up to the 1st March 1904.

MINING EDUCATION.

The time has come when our youngmen should begin to crowd the mining and geological classes of our Government Colleges. The Government of Bengal has recently formulated a scheme for imparting instruction in practical mini[illegible] the Shibpur Engineering C[illegible] We take this opportunity to [illegible] the would-be aspirants to th[illegible] Technical Scholarships tha[illegible] recently been announced that none of these would be available to any student who has not undergone in some part of India or other a thorough course of lectures on the subject for which the scholarsship of the year is awarded.

TATA EDUCATIONAL SCHEME.

The following Notice; dated Bombay, was issued for 1906—

"Two studentships enabling the recipients to proceed to Europe for the acquirement of some special

knowledge in any Department of Science, Art or Engineering, or for fitting themselves to enter the higher branches of Government service, are open for competition by selection only to graduates who have displayed marked ability throughout their University career. One studentship is confined to Parsees only, while for the other any pure native of India, including Native Christians, may compete. Applications will be addressed to the Secretary of the scheme, ...pri Buildings, Fort, Bombay, ...copies only of certificates as ...he applicant's age (which ...d be authenticated), nativity, ...cter, physical fitness, and ...tional qualifications. Consent ...arents or guardians to the candidate's proceeding to Europe for the prosecution of higher studies should also be annexed to the application, and a copy of his photograph enclosed. A copy of the terms and conditions of the Scheme could be obtained from the Secretary by all duly-qualified candidates."

It is not yet announced if the studentships would be repeated from year to year.

MADRAS 'NATIONAL FUND' FOR FOREIGN EDUCATION OF INDIANS.

The Indian Arts Encouraging Society, is organising a "National Fund" to be utilised for the purpose of sending young men for industrial training in Japan and America, and for other similar benevolent purposes. The "National Fund" shall be formed by raising yearly voluntary contributions from the residents of the principal streets of Madras on every *Deepavali Day*, by means of an organised band of devoted young hopefuls. For the same fund similar measures are being adopted in Salem, Coimbatore and Trichinopoly. Those in other district centres who wish to help in this cause are requested to communicate with Mr. G. Subramania Iyer, B.A., the Secretary of the Society.

INDIANS AND SCIENTIFIC EDUCATION IN EUROPE.

Dr. P. C. Roy, Prof. of Chemistry in the Presidency College at Calcutta, recently returned from

urope where he had been to see nd work in some of the celebrated hemical laboratories.

In an interview with a repreentative of the '*Sanjibani*' of alcutta, he spoke very enthusiasically and admiringly of some of he European professors of hemistry and offered the following emarks :—

"Wherever I have gone I have ound the people eager for scientific culture. What a deep thirst for nowlede and what a strong spirit of research and investigation here witnessed! How numerous are he scientists and students of science! How great is the number of libraries! But what a contrast in all these respects does our country present! Even in England among the 250 Indians that I saw there, not a single one was devoting himself to the sciences or technical arts. Without the cultivation of science there is no hope of real progress and advancement. It is not simply physical strength or courage that has made Japan great. Japan took to scientific pursuits at the very start of her progressive career. Even now I found Japanese students of science in many places in Europe. They are engaged deeply in original researches. But I found no Indian students any where there. The Bengalee poet has truly sung "It is only India that slumbers." There are two places in my opinion where Indians can well be sent for technical education. They are Leeds in England and Geneva in Switzerland. The "Yorkshire College of Science" is the name of the chief institution for the teaching of science in Leeds; it is affiliated to the Leeds University. The Chancellor of this University is Lord Ripon. Applied Chemistry is most excellently taught in this college. Spinning, dyeing, and tanning are each taught here by more than one expert. Here spinning both by handlooms and machine looms is taught. ought to send there In youths to learn spinning, so in future Manchester may cea make its millions out of our i rance to make our cloth. Prof. Proctor, who is in charge of the Tanning Department, is the greatest authority in the chemistry of tanning in Europe. How the hides exported from India are made into leather, Morocco, Russian and calf, he explained to me, as he showed me over the institution. Any youth who has studied up to the textbook on Chemistry in the B. A. (Honours) examination of the Calcutta University can master tanning in three or four years by attending the tanning Classes of the Yorkshire College of Science at Leeds. I went over to Geneva in Switzerland and made a thorough inspection of the great institution for the teaching of watch-making

there. I was under the impression that no foreigners were admitted into this institution, but on inquiry I came to know from the authorities of the school that my impression was wrong. All foreigners are admitted into it. One can master the art of watch-making in three to five years. Geneva is a particularly healthy place. The living is cheaper than in England. French is the medium for talk and instruction. One ought to learn French before coming here.

Those who are anxious to have information about the institu- for the teaching of watch- ng in Geneva will do will to their enquiries to the follow- address :—Buneande Renseig nements, 3 Placedes Berques, Geneva, Swisse.

THE VICTORIA JUBILEE TECHNICAL INSTITUTION, BYCULLA BOMBAY.

If we are to start mills and factories we should have trained men first, and it is not possible for everybody to go to foreign country and learn all their arts and industries, moreover we should learn first what India can teach us and what we get near at hand. We have no school in Bengal of the type of *Victoria Jubilee Technical Institution, Byculla, Bombay,* so let us first of all get some youngmen trained in it. I think there are good many boys now available for such a useful school particularly as many students are leaving the arts schools and colleges affiliated to the Calcutta University for various reasons. *This school teaches* Mechanical Engineering, *Textile manufacture,* Electrical Engineering and Enamelling. Students who have read up to the Entrance or school final standard can enter this school. The full course in each department extends to 3 years. There are I think about 200 students in this school, but only about half a dozen of them are Bengalees. There is no school of this type in Bengal. Its Session begins from January, for other particulars, the principal of the Institute may be communicated with.

I. This institution is the only one of its kind in India having three different courses of study (*a*) Electrical Engineering (*b*) Textile manufacture including spinning and weaving (*c*) Mechanical Engineering.

II. The students in the various Departments receive both theoretical and practical training during the whole course of 3 years.

III. A Calcutta University student who has read up to the F. A. standard may be admitted.

IV. The expense for a moderate

student would not exceed *Rs. 30 per month.*

V. There are at present 8 or 10 Bengali students in the various departments from various parts of Bengal.

VI. The session begins early in January.

VII. A *detailed prospectus* of the *Institute can be had from the Principal* of the above Institute. Price as. 6.

VIII. The test exmination in drawing which seems to be a point of general enquiry is not very difficult to pass.

IX. A knowledge of free hand drawing necessary to pass can be picked up within a month.

X. The number of students that can be admitted in each department is limited.

PROJECTED TECHNOLOGICAL COLLEGE IN BENGAL.

A deputation of the Association for the advancement of scientific and industrial education of Indians consisting of Maharaja Manindra Chandra Nundy, Raja Peary Mohun Mukherji, Mr. D. M. Hamilton, Babu Norendra Nath Sen and Babu Jogendra Chundra Ghose, waited upon the Lieutenant-Governor with the scheme of a Technological College and His Honor was graciously pleased to promise to extend the present Shibpore College in order to convert it into a proper Technological College, adding chairs for teaching various industries. The additional expense for the teaching staff would alone be about Rs. 50,000 and necessary allotment of money has been made in the Budget.

THE VICTORIA JUBILEE HINDU TECHNICAL INSTITUTE LAHORE.

The industrial chemistry class, attached to the Victoria Diamond Jubilee Hindu Technical Institute, Lahore, is now in regular working order, and the authorities are prepared to take regular students for a complete course (syllabus on application) on payment of Rs. 3 as monthly fee. To elective students for special courses the following fees will be charged:—Chemistry Rs. 10 a month; soap-making Rs. 100 and India rubber-making Rs. 500 for complete course.

THE CHAMARAJENDRA TECHNICAL INSTITUTE, MYSORE.

The Industrial school at Mysore will shortly rise to the dignity and usefullness of a Technical Institute. More than 2 lakhs of rupees will be spent on the building. All kinds of industries will be taught there on scientific principles. His Highness the late Maharajah used to take much interest in the development of Industries. The Institute will therefore be called the Chamarajendra Technical Institute. The foundation stone was laid by His Highness the Prince of Wales the other day.

AGRICULTURAL COLLEGES IN INDIA.

I

The Pusa Research Institute.

The Agricultural College and experimental Farm at Pusa in Durbhangà is now an accomplished fact. In Madras there is an Agricultural College and Farm at Saidapet, in Bombay there is one at Poona, in the United Provinces of Agra and Oudh there is one at Cawnpore and in the Central Provinces there is one at Nagpore. The want and need of Bengal in this line has been removed by the establishment of the College which has been made possible by the opportune donation of £30,000 by Mr. Henry Phipps, the friend and partner of Mr. Andrew Carnegie. The College has been planned in a very elaborate way and is bound to be the premier College of Agriculture and the most satisfactory and well-equipped laboratory for Agricultural Research in all India. Mr. Bernard Coventry of the Dalsingh Sarai Estate in Behar is the Director of the Institute and he is assisted by a Bacteriologist, a Biological Botanist, an Entomologist and an Agri-horticulturist, together with a large staff of minor teachers. There will be a cattle farm attached to the College. The insruction will be conveyed in English and the curriculum of the College is at present intended to include (*a*) Agriculture, (*b*) Chemistry, (*c*) Botany, (*d*) Agricultural Geology (*e*) Agricultural Physics and Mechanics with some knowledge on veterinary science, land survey and practical farm management.

Rules of admission, &c., can be had on application to the Principal.

(II)

College of Agriculture Saidapet.

1. The college is intended to afford instruction to persons who desire to become acquainted with the theory and practice of Agriculture, more especially that of South India, as well as to students preparing for examination in the subjects prescribed for the diploma in Agriculture under the Madras Government Technical Examination scheme.

2 The course of instruction shall ordinarily extend over three years, and shall include both theoretical and practical instruction and comprise following subjects.

Agriculture.
General Chemistry.
Botany.
Meteorology and Geology.
Surveying and Levelling.
Anatomy and Physiology.
Agricultural Engineering.
Agricultural Chemistry.
Veterinary Science and Hygiene

3. The number of students in each class shall not ordinarily exceed thirty.

4. Admissions shall ordinarily be made once a year on or about the 1st of January, and at other times with the special sanction of the Director.

5. Casual students, *i.e.*, students taking up one or more subjects only shall be permitted to attend the lectures and practical classes in those subjects, subject to the general regulations of the college.

6. There are twenty-one district and six special scholarships, in connection with the college.

7. Of the twenty-one district scholarships, seven are awarded annually, in rotation, in the following order :—

One year, Ganjam, Cuddapah, the Nilgiris, South Arcot, Gadavari Trichinopoly, Anantpur—7 Districts; next year, Kistna, Tinevelly, Tanjore, Malabar, Bellary, North Arcot, Coimbatore—7 Districts; the third year, Vizagapatam, Nellore, Kurnoole, Chingleput, South Canara, Salem, Madura—7 Districts.

8. The scholarships are awarded by the Director to nominees of collectors of Districts. Six special scholarships are intended for Muhammadans and for members of backward and indigent classes as defined in the Grant-in-aid Code.

9. The scholarships are tenable for thirty-six months counting from the 1st January of the year in which the student joins the college, and amount to Rs. 10 *per mensem* during

the first year, Rs. 12-8-0 *per mensem* during the second year, and Rs. 15 *per mensem* during the remaining period.

10. Scholarship-holders to special courses shall be exempted from payment of fees.

11. All other students shall pay the following tuition fees in advance :—

For all the subjects included under the diploma in Agriculture—Rs. 30 per session.

For single subject as above—Rs. 10 per session for each subject.

Muhammadans and backward and indigent classes shall pay half these fees,

12. *Qualifications for Admission.* Persons from all parts of India are eligible for admission into the College, provided they have passed the Matriculation or the Entrance Examination of an Indian University or the Madras Government Upper Secondary Examination.

Candidates who do not possess the educational qualifications mentioned above may be admitted as paying students by the special orders of the Director, on the recommendation of the Principal, provided they possess sufficient general knowledge to follow the Course of instruction given in the College. Without the special orders of the Director no candidate shall be admitted whose age is under sixteen or above twenty-five years, unless he be already in the service of the Madras Government.

The following concessions have been conferred by Government on passed students of the college :—

(a) Government guarantees and appointment on Rs. 40 a month to the student who, at the end of his third year, obtains the highest number of marks in the diploma examinations.

(b) The Revenue Test, higher grade, shall be open to students of the college who have obtained the diploma in Agriculture at the Government Technical Examinations.

(c) The Criminal Judicial Tests, higher and lower grades, shall be open to students of the college who have obtained the diploma in Agriculture at the Government Technical Examinations.

(d) The diploma is a necessary qualification for the following posts :—

Native assistants to the Director of Agriculture, Agricultural Inspectors, Farm Superintendents, Deputy Commissioners of Revenue Settlement, As-

sistant Commissioners of Revenue Settlement, Supervisors of Revenue Settlement and Teachers of Agriculture for classes of the intermediate standard.

(e) Students who have passed in surveying and levelling and agricultural engineering for the diploma are qualified for the post of sub-overseer in the minor irrigation department.

(III.)

Agricultural School, Cawnpore.

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(1) It is under the control of the Director of Land Records and Agriculture. The Director of Public Instruction is a visitor on behalf of Government.

(2) The full course of study occupies two years. The school terms will be from the 1st July to 24th December and from 2nd January to the 30th April.

(3) The school is for the instruction of—

(a) sons of landowners and agriculturists who wish to fit themselves for agriculture or estate management;

(b) persons wishing to qualify as teachers of agriculture in State schools;

(c) candidates for kanungoships and other revenue appointments.

(4) Candidates for admission under sections (b) and (c) must have passed at least the Entrance or the School Final Examination of the Allahabad University or of some other Indian University with Urdu or Persian as their second language. Candidates under section (a) who have passed the English Middle Examination may al[so] be admitted for the present if the[ir] knowledge of English is sufficie[nt] to enable them to profit by th[e] course.

(5) No person will be admitted who is physically unfit for practical work, and who is under 16 years or over 21 years of age.

(6) Students belonging to class (c) will be admitted on the nomination of Collectors of Districts to a number not exceeding 25 in each year.

(7) Applications for admission must be submitted in writing to the Principal before the 30th May, stating qualifications.

(8) No tuition fee will at present be charged, but students must make their own arrangements for boarding, unless they are permitted to occupy quarters in the Boarding

house attached to the school, where there is accommodation for 36 boarders only.

(9) There are at present eight scholarships of Rs. 5 per month each.

(10) The course of study comprises :—

Agriculture (theory and practice).
Surveying (theory and practice).
Chemistry (theoretical and practical).
Agricultural chemistry.
Botany.
Physiography and physics.
Veterinary Practice.
Drawing (omitted for the present).
Duties of kanungos (for candidates for kanungoships).

(11) A final examination is held the end of the second year and rtificates given to those who pass.

AGRICULTURAL DIPLOMA.

The Board of Agriculture in India has recommended to the Government of India, that some form of Degree or Diploma should be conferred by Provincial Agricultural Colleges and that to secure uniformity among the Colleges a combined Diploma, which should be recognised as equal to the B. A. Degree, should be given. The exact title of the Degree it has been suggested should be Licentiate of Agriculture (L. Ag.) which has already been adopted by the College of Science at Poona in the Bombay Presidency.

COMMERCIAL EDUCATION IN CALCUTTA.

In accordance with the recommendations of the Committee appointed to consider the question of commercial education at the Calcutta Presidency College, the Bengal Government have directed that there shall be two courses of study, one compulsory and the other optional. The former will be a day course, and latter an evening course. The day course will comprise :

(i) English (modern) and specially English correspondence including commercial correspondence, letter drafting and precis writing.

(ii) Arithmetic, including commercial and mental Arithmetic ;

(iii) One of the following subjects, namely Bengali, Hind

Urdu, Uriya, French, German, or Latin ;

(iv) One of the following subjects, namely, book-keeping, Short-handwriting or type writing ; and

(v) Commercial history and Geography

This course will extend over a period of two years, at the end of which there will be an examination.

The evening course will comprise :

(i) Outlines of political economy.

(ii) Banking and currency ,

(iii) Commercial and industrial law ;

(iv) Annuities and insurance ;

(v) Book-keeping ;

(vi) Shorthand-writing.

(vii) Type-writing, and

(viii) English (Modern)

APPRENTICESHIP IN MILLS.

Important Correspondence.

In connection with the teaching in mills of spinning and weaving *gratis*, the enclosed letters speak for themselves, and we dare say, will be interesting reading.

(*1*) *Delhi*.

Saran and Company, Limited.

Jumna Mills, Subzimundi.
Delhi, 24th March, 1906.

No. FIOO.

To Babu Kisori Mohan Gupta, M.A.
Dawn Society
22, Sanker Ghose's Lane, Calcutta.

Dear Sir,

In reply to your letter of the instant, I am directed by Managing Director Rai Saheb Girdhari Lall to inform you the offer which he made at the Industrial Conference held at Benares, to admit students, desirous of learning the art of cotton carding and spinning at the above Company's mills, has been confirmed by the Board of Directors of the Company at a meeting recently held.

In compliance with the Board's decision we are trying to engage a good practical and clever man who would be able to teach the art to students. As soon as such a man is secured we shall let you know. In our opinion, cotton carding and spinning cannot be mastered without the application of devoted attention to work for at least 3 years at a mill.

I am also directed to tell you that the offer he made was not to admit all or any number (indiscriminately) of students who will apply for the pupilship, but only a selected few. As soon as the Company is in a position to take up apprentices, they will do so, and give notice of the same in newspapers. Your friend's application is on our file and will receive our first and foremost attention.

I must tell you that students who will be admitted to learn practical carding and spinning will have to arrange themselves about their ing and lodging, the Com- not being in a position to he students in that direction.

re are a number of Bengali men living in Delhi, and it would be better if you would enquire of any of them about the cost of living in Delhi during the apprenticeship of the Bengali students.

Yours faithfully,

For Saran & Co., Ld.,

(Sd.) G. K. Tipins,

Manager and Engineer

(II) Ahmedabad.

From Mr. C. Y. Chintamoni, late Secretary, Reception Committee, Industrial Conference, Benares.

The Industrial Conference, General Secretary's Office :

No. 227 of 1906.

Amraoti 25th March 1906.

My dear Mr. Kishori Mohan,

Here is the reply to my letter received from Mr. Keshori Lal Mahasukharam of the Ahmedabad Fine Spinning and Weaving Co. Ld.

We made an offer at the Benares Conference to teach the art of weaving to any of our Indian brothers who is willing to work in that line, and we shall be very glad to teach any candidate who comes to us. At present, I have got one Bengali candidate who has come through the Editor of the *A. B. Patrika* and he is learning the art of weaving very well. Any candidate who wants to come here to learn shall have to make his own arrangements for food and lodging. He must follow our instructions. He shall have to work hard as he will have to deal with iron machinery. *We shall teach him the art without any charge.* We cannot

teach spinning as we are only weaving masters.

I shall be glad to hear that your friend will be able to avail himself of the above offer.

Yours truly

(Sd.) C. Y. Chintamoni.

(III) Bombay.

Applications are invited for apprenticeship at a first class Cotton Mill in Bombay. The candidate must be a graduate in Physical Science and Chemistry of the Calcutta University with knowledge of practical Chemistry or of machinery. The selected candidate will have to procee d to Bombay and for three or four months to live at his own expense but no premium will have to be paid. On the apprentice's work being found satisfactory he will receive an allowance of Rs. 50 per month after that period and on his continuing to work satisfactorily, he will receive an annual increment of Rs. 25 and at the end of his third year he is thus expected to get Rs. 126 per month. The mill where he will learn will have the option of employing him for another two years with a man who has proved efficient in bleaching and dyeing or spinning and weaving or mill engineering and mill management. This will lead to posts of higher emoluments and profits. Applications are to be addressed to the Hon'ble Mr. J. Choudhuri at 62, Bowbazar Street, Calcutta. No one who does not answer to the requisite qualifications need apply. A certifiacate of physical fitness and capacity for hard manual work should be appended with the application. The applicant must also state in his application that should he be selected he will co[illegible] with the conditions of appren[illegible]ship.

TECHNICAL EDUCATION IN JAPAN.

For the sake of guidance and information of Indian students willing to come over to Japan for scientific and industrial edcation I write the following notes, which I hope will be of great use to them.

College and School Education.

There are two Imperial Universities at Tokyo and Kyoto and

four Higher Technological schools at Tokyo, Koyto, Osaka and Nagova. Besides these there are many Industrial schools of lower grade.

In the University of Tokyo there are among others, Colleges of Medicine, Engineering, Science and Agriculture.

In the College of medicine there are two courses of (1) Medicine (4 years), (2) Pharmacy (3 years).

In the College of Engineering there are nine courses each of which nds for three years (a) Civil neering, (b) Mechanical Enging, (c) Naval Architecture, (d) nology of arms, (e) Techno- of explosives, (f) Electrical neering, (g) Architecture, (h) Applied Chemistry, and (i) Mining and Metallurgy.

In the College of Science there are the following eight courses each of which extends for 3 years.

(1) Mathematics, (2) Astronomy, (3) Theoretical Physics, (4) Experimental Physics, (5) Chemistry, (6) Zoology, (7) Botany and (8) Geology.

In the College of Agriculture there are the following four courses each of 5 years' duration.

(1) Agricultura re, (2) Agricultural Chemistry, (3) Forestry and (4) Veterinary medicine.

In this college, there is a department for sericulture which can be joined for one year.

In the University of Kyoto all the above subjects are taught.

The Higher Technological school of Tokyo has provisions to teach the following subjects each of which extends for 3 years.

(1) Dyeing and weaving, (2) Ceramics (Procelain, glass, cement bricks, tiles, etc), Applied chemistry (Cosmetics, drugs, brewing, sugar refining, oils etc,) (4) Mechanical Engineering, (5) Electric Engineering, (6) Electro-Chemistry, (7) Industrial designs and (8) Architecture.

The above subjects are taught also in the other three Technological schools.

In Tokyo there is an Imperial School of Arts in which the following subjects are taught.

(1) Painting (2) Sculpture, (3) Bronze and metal work (statues etc) and (4) Lacquer works. Each of these courses extends for 4 years, but an Indian student may find it convenient to study for 3 years.

Technical School for Ladies.

For females there are many schools of arts where Indian ladies can study with advantage.

The subjects taught are (1) Painting, (2) artificial flower making, (3) Embroidery, (4) Sewing and knitting and (5) Lacquering and (6) Sculpture.

Out of these courses one or more may be chosen at a time. The duration of the courses is from one year to more.

PRACTICAL EDUCATION IN FACTORIES.

There are some subjects which can be only learnt by working in factories, while studying the theoretical portions at home. The following subjects might be chosen. Matches, pencil, buttons, wire-drawing (needles, nails etc), metal sheet work, umbrella, weaving, knitting, soap, paper making, felt cloth making, tools making, etc. etc.

GENERAL INFORMATION.

1. The sessions in all the institutions begin from September.

2. Candidates for admission are to send in their applications by the middle of June while staying here.

3. The school and college fees will not exceed 3 yen per month (1 yen is equal to 1½ Rs).

4. The class lectures are in Japanese language with very little of English. The important books are in English or German.

5. Students are advised to reach Japan by the month of March and study Japanese.

6. As large numbers of students from China, India, Philippines, Corea and Siam come to study here and since there is a limited number of seats, it is becoming very difficult for foreigners to get seats. So students should come here early, send their applications through proper channels, study Japanese and German in the meantime and well equipped to avoid disappointment.

7. Students may live in Japanese hostels with an expenditure of 15 to 20 yen per month or in messes formed among themselves with the same expense. (Boarding and lodging only)

8. Students should dress in the European fashion which is prevalent here and much appreciated. The temperature in summer rises to 30 deg. F. and falls in winter to the freezing point. Good summer and winter dresses should be brought from India to suit the climate. Beddings, rugs, blankets, thick quilts, mosquitocurtains will be necesseary. Dresses and books are very dear here.

The total expenses will be 40 to

is of course only by special courtesy that non-residents are given seats.

Just now there is a great rush of students from China to whom as a rule particular perference is shown. Much consideration and courtesy are no doubt shown to the students form India but the number of seats being limited, it is not unoften the case now-a-days that one has to wait some time before a vacancy is caused and he can get admitted.

N. B.—For full particulars, the reader is referred to a booklet in Bengalee just published under the name of "Japaner Katha O' Shilpa Sambad"—Containing, among others, a series of highly interesting and informing letters from Mr. Ambica Charan Ghose a scholar of the Scientific and Industrial Association in Japan.

AGRICULTURAL EDUCATION IN JAPAN.

The Institute at Sapporo.

In the *Westminister Review* Mr. Hobert Reade doubts if any English colony can show an institute for teaching agriculture comparable with that of Sapporo, the capital of Hokkaido, Japan's greatest colonial dependency.

The Sapporo Institute has around it an estate of 6,000 acres, with much land elsewhere. From these it draws most of its revenues.

The professors were originally Americans, but have now been replaced by Japanese trained at the Institute. The length of the course of studies has been fixed at four years.

The fees are about nine yen or eighteen shillings per session of three months, payable in advance. Discipline is maintained chiefly by expulsion in case of idleness. A preparatory school, a practical agricutural school, an engineering and a forestry school are attached to the Institute. In the first two the course is of two years; the Civil Engineering diploma can be won in three, as can that of the Forestry School.

The object held in view at Sapporo is not only to train a staff for the Japanesee Board of Agriculture, but to educate managers of farms sugar refineries, distilleries, and the like, and also to build up a competent forestry department.

The course in the preparatory school, which the pupils enter when $17\frac{1}{2}$ years old, is a two years' one.

During the first year the scholar studies English, modern history trigonometry, mechanics, acoustics heat, inorganic chemistry, [illegible]

and geometrical drawing, and drill. Instruction in Chinese furnishes a link with the past of Japan. Lessons in ethics remind us that we have to do with a non Christian land.

German, analytic geometry, and the calculus are reached in the second year, together with surveying, morphology and classification of phanerogams, mineralogy, geology, optics, magnetism, electricity, and organic chemistry.

Students going on to the three years' higher course have a formidable syllabus before them.

They devote much time to natural science, cultivation, soils, and the means of improving them and agriculture. Meteorology, the theory of agricultural machinery Zootomy, political economy and farm management, veterinary science the maladies of plants, entomology, so far as it concerns noxious insects, horticulture, and manures are also studied.

Sapporo gives huge doses of theory, but it remembers practice.

During these three years practical instruction, beginning from the first year, is given in the management of horses and oxen, in using agricultural instruments, and machines growing crops and vegetables, rearing and tending fruit trees, preparing manure, and making tools.

Most of these subjects are continued in the second year, when the student also learns how to rear silkworms, clear and drain land, prepare flax and hemp, milk cows, and make maple sugar.

In the third year he is also taught to prepare cheese, condensed milk, hams, salt meats, oils, bread, and starch, dry fruits, and vegetables, ferment alcohol, and make soy and vinegar.

Gymnastics, on the German system, and military drill, form also leading features in the student's work. In a word nothing to chance.

Affinity Between India Japanese.

In last March Principal Motoda of Formosan College, Tokyo, delivered a lecture "on the educational system of Japan." at the Town Hall in Benares. He said that 98 per cent in Japan can read and write. Girls up to 14 must go to school. There are two Goverenment Universities, besides many private Universities. He dwelt upon the moral and intellectual training of Japan and he concluded saying that there is affinity between Indians and Japanese, and what Japan has done India can do, [illegible] of India is shame of Japan [illegible] is pride of India [illegible] Japan.

INDO-JAPANESE ASSOCIATION.

A meeting of the Indian students was held in Tokio, when it was resolved to give every possible help and informations to Indian shopkeepers and merchants as regards Japan's industries and exports. The Secretary writes :—

"We will always be at the service of our countrymen willing to correspond with us for informations
ies and introductions of
e goods and merchants.
pondents are requested to
he letter always stamped
pice stamps. Letters to
dressed to the Secretary, Indo-Japanese association 16 Nishisugacho, Hongo, Tokyo, Japan.

This year there are 31 Indian students in Japan. Out of these students, 16 come from Bengal, 2 from Behar, 2 form N. W. P., 1 from Panjab, 4 from Bombay and 6 from Nepal. The subjects taken up by them are—applied chemistry, Pharmacy, tanning, Porcelain, glass, mining and metallurgy, Lacquer works, pencil, soap, matches, weaving and dying, agriculture, silk and sericulture and technology of ... and explosives and cotton-

WHAT NOT CAN JAPAN SUPPLY TO INDIA.

What not can Japan supply ? Silk, glassware, porcelain, cement, metal works, matches, pencil, soap, metal-wire, nails, needles, pins, gas and oil engines, buttons, cigarettes, important manufacturing machines, toys, chemicals, paints, colour, scientific apparatus and everything that can be expected from other civilised nations of the world.

Japan can supply very nice engineering and drawing instruments the students of all the engineering institutions may send orders for them.

LIST OF INDUSTRIES WHICH CAN BE WELL LEARNT IN JAPAN.

(1) Mining (2) Glass (3. Pottery and Ceramics (4) Porcelain (5) Cement (6) Enamel (7) Oil-refining (8) Mechanical Engineering (9) Electrical Engineering (10) Shipbuilding (11) Architecture (12)

Medicine (15) Pharmacy (16) Soap (17) Candle (18) Match (19) Pencil (20) Knitting and embroidery (21) Tanning (22) Fish oil tinning, and brinecatting or curing (23) Paint (24) Umbrella frames (25) Buttons (26) Tooth brush (27) Bamboo work (28) Paints and Lacquerwork (29) Condensed milk (30) Weaving (31) Reeling of waste silk (32) Metal Casting (33) Watch and Lamp making (34) Cigars and Cigarettes, (35) Agriculture.

The above catalogue is in part the result of advice received from a Japanese gentleman of position and in part of the first hand reports of Indian scholars in Japan.

JAPANESE RAILWAY GUIDE.

The Japanese Government has been pleased to forward to the Calcutta consulate some copies of guide to Imperial Government Railways of Japan to distribute among the people of India who intend to go to Japan.

The guide may be had on application to the Acting Consul-General for Japan.

LIST OF STEAMER SAILINGS.

Messrs. Balmer Lawrie & Co. of 103 Clive Street, Calcutta have issued a list of steamer sailings during the next passenger season, under the auspices of their firm. The list cannot fail to be of interest to those about to travel abroad.

Messrs. Balmer Lawrie & Co. arranged for the passages of 91 Indian students to Europe, America and Japan this year.

FOREIGN LANGUAGE CLASS...

A language class has been start-ed in Calcutta since a under the auspices of th tion for the Scientific an Education of Indians fo fit of persons bent up travel. It is held in the rooms o the Albert Hall, College Square twice a week for each subject thus:—

Language	*Professor*	*Days of the we*
German	Miss Albers	Wednesday Sunday
French	M. Foncher	Tuesday & Friday
Japanese	Mr. Nishide	Monday & Thursd

The monthly tuition fee is Rs for each language.

One other language class Calcutta under private ment, is known as the Institution and is situated in niktola Street.

Books to Help the Study of Japanese.

1. Japanese Conversation by Motsu

2. Colloquial Japanese by Chamberlain

3. English Japanese Dictionry by Satow

4. Do by J. C. Hepburn M. D. L.

5. Kelly and Walsh's Hand Japanese language

...rgast's Mastery system the Japanese or English ...own D. D.

...rough's Japaneseg rammer self taught by H. Weintz.

Enquiries for these books and similar others may be addressed to Maruya, Nihonbashi, Tokyo. Some of them may be had of Messrs. W. Newman & Co, Thacker Spink & Co. and the School Books Society, Booksellers, Calcutta.

COST OF LIVING IN AMERICA.

The cost of a student in America tuition fees included is about 2 to 3 times as much as in Japan.

A sufficient knowledge of the Japanese language is a *Sine qua non* to a student in Japan caring to profit by the lectures in the class which are delivered in Japanese in America, no such language restriction stands in the way —as, English is the current language.

In America, a clever young man has opportunities of earning a living more easily than elsewhere in the world by some job or other during off time—which do not however exist in Japan.

Comparative Cost of Living in Europe and Japan.

The comparative cost of living in Europe and Japan may be gathered from the fact that a Chinese student sent by the Government to Europe costs the State anything between £ 120 to £ 400 a year, while in Japan, he costs only from £ 18 to £ 40 a year.

INDIAN BOARDING HOUSE IN AMERICA.

"We notice with great satisfaction that a movement has been set on foot by some of the students who are now in America to open an Assam or Indian boarding house in that country. There is such a

boarding house now in Tokio in Japan, and another in America will assuredly be of great use to the cause of scientific and industrial education of our youths. We wish every success to the movement, and trust its promoters will receive every possible help from this country." *Indian Mirror.*

INDIAN STUDENTS IN AMERICA AND INDO-AMERICAN ASSOCIATION.

Mr. M. C. Sinha, O. A. C., Corvallis Oregon, America. writes:—"I believe you are aware of the fact that there are quite a lot of Indian students in America. There are at present five Indian students in the Oregon State College, Corvallis; two from the Punjab, two from the United Provinces and one from Bengal. We have sarted an Indo-American Association with a veiw to promote friendliness between India and America, and to help all students from India in any way we can. The recent news from Bengal interests every member of the Indo-American Association, and we feel specially delighted when we hear of the success of the Swadeshi Movement. The rumour that Bengal is going to establish a National University has given us one more occasion to be proud of our mother land. Everybody here admires the public spirit of Bengal and every one says that a nation which can show such a remarkable power of combination and organisation, is destined to play a great part in history." He adds "Every move in the (Swadeshi) direction enhances our prestige in the country."

Intending Students to America: some Tim[ely] Advice.

It is necessary to create good impression in American minds in order to be successful there. They like tolerably good looking youngmen of active habits. They hate the negroes; and persons of dark complexion coming from whatever country, produce in them a bad impression at the first sight. We have now begun to go to America, and if the first batch of youngmen who go there succeed in creating good opinion, it will help a great deal in their tolerating the shortcomings of those who may follow. The Chinese did not make use of this caution at first and as a result, they are not looked upon with a favourable eye by the Ame[ricans]

ricans. The Chinamen whom the Americans first came in contact with were Chinese coolies, hence their general dislike of the Chinese.

Our present crying need is a knowledge of Western Scince and Industries. It is therefore urgently necessary that Indians in large numbers should go to America. Anyhow manage to secure Rs. 500 and then start for America. Asiatic Coolies are seen travelling as leck passengers over all parts of he world, and why should you ceep back because you cannot
or a higher class fare ? Just
ng, the American Emi-
office will require you
that you possess at least
vith you. By all means
e only this amount. Those who desire to go to Babu Girindra Nath Mookerjee of Portland, should avail themselves of the boat to Portland or to Canada, rom Yokohama (Japan). After reaching Canada one has to arrange at first for a pass at the Emigration office ; then take the rain for Portland. After reaching Portland one has to avail of the Corvallis car to go to the Agricultural College. Here he will find Girindranath or Maheschandra Singh. There is also an Indian at the Y. M. C. A. in Sanfrancisco. Indians desiring to go there, should go by the Sanfrancisco Steamer from Yokohama. An important fact shall not be forgotten. Indian Steamers to Japan stop at Hong-Kong ; there, Indian Coins should be exchanged into American Dollars.

Students willing to go to America for study shall have the following qualifications:—

Age—Not less than 16, must be healthy and morally good.

Education—Must not be less than Entrance class.

Pecuniary condition—Must have at least Rs. 500 with him.

Dress—Must have at least two suits of dress.

General appearance—Must not be very dark in complexion, nor positively ugly.

Such students should take with them as little luggage as they can —Just sufficient to be able to carry themselves. They can conveniently cook their own food on board the Steamer. If sea-sick, they should not go to their beds but run about and play on the deck. If very much sea-sick, should drink some sea-water in the morning. Should not keep an empty-stomach. An Englishman, Dr. Gibbard of Sanfrancisco is very willing to help Indian students in all matters he can. He intends opening an 'Indian Cottage' here in the vicinity of Schools and Colleges, to give shelter to Indian students. Efforts will be made to arrange for very cheap living there.

We know of more than one concrete case where the Indian student while regularly keeping his term at the College, is, during off time, earning a decent living by some clerical or other job.

CERTIFICATE OF IDENTITY NECESSARY FOR AN INDIAN STUDENT GOING ABROAD.

(a) For Japan.

The Education Department of Japan has got in force a rule that applications on the part of foreign students for admission to schools in Japan must be made through the Diplomatic or consular Representative of the country concerned in Japan.

As for Indian students, the Governmet of India do not desire that such applications should be made to the Japanese education Department without some guarantee as to the character and antecedents of the persons on whose behalf such applications are to be made. Accordingly it has been ordered that "Indian students proceeding to Japan for their education should before their departure from India, provide themselves with an authoritative certificate of identity in the form appended, signed by the head of the district (in a Presidency town, the Commissioner of Police) in the case of of residents of British India and by the Political officer in that of residents of Native states. The District or Political officer will endorse on the certificate of identity his opinion whether the person is a British subject "by birth" or "by naturalization" (or a subject of a Native State or not."

FORM OF CERTIFICATE IDENTITY.

1. Name of applicant—
2. Fathers name and caste—
3. Residence—
4. Age of applicant—
5. Nationality of applicant—
6. Social and pecuniary status of father (or guardian)—
7. Date of probable departure of applicant from India.
8. Object of applicant's visit to Japan.

(*b*) *For England and other European Countries.*

(Government of India Resolution of December, 1899)

The Secretary of State for India has brought to the notice of the Government of India that it not unfrequently happens that natives of India, students or others who have proceeded to England desire to obtain passports to enable them to travel to foreign countries in the possession of a pass-port essary or desirable and that ty often arises from want ence to show that the appli- a British subject, and therefore entitled to a pass-port. Appeals for assistance are also frequently addressed to His Lordship by destitute Indians who desire to return to their country and by students who, owing to embarrassed circumstances are unable to complete their course of education.

In order to enable the Secretary of State to deal with such cases satisfactorily the Governor General in Council had decided that Indian Students and others visiting England should provide themselves, before their departure from India, with an authoritative certificate of identity (in the same form as above for Japan, only substituting England for Japan, and signed by the same class of officers).

For a student the certificate should be signed by the head of his last school or college and countersigned by District officer (in a Presidency town, the Commissioner of Police) or Political officer as the case may be.

The District or Political officer or head of the school or college will not refuse an applicant a certificate if his means do not appear to be sufficient to enable him to effect his object, but will merely attempt to dissuade him from undertaking the journey, pointing out the difficulties in which the applicant would be placed were he to find himself in a foreign country without sufficient means.

The possession of a certificate of identity will especially be very useful to young men of good family, as it will enable the Secretary of State to obtain for them social and other attentions which may prove of great value.

The District or Political officer will endorse on the certificate his opinion whether the person is a British subject "by birth" or "by naturalization" (or a subject of a Native State) or not.

(Published in the *Gazette of India* for general information.)

A CAUTION TO STUDENTS WILLING TO GO TO AMERICA.

Tokio (Japan), July 1906.

The Indian students who intend to go to America, should try their best not to come *via* Japan. This route, though preferred by many, is not without its disadvantages to those who are not recognised as white. Owing to the emigration laws and for reasons best known to the port authorities here, the medical examination at Yokohama is too stringent. It is hardly possible for the Indian students to pass the medical examination at the first chance. Even after this tiring medical examination, when one has reached the shores of America, the so-called land of equality and fraternity, there is every chance of his being sent back by the port authorities of that place. I don't know the underlying reason, if there is any; but explicitly, permission of getting on the land is refused on a flimsy ground of medical unfitness.

I give below a few recent occurrences. Mr. Rathindra Nath Tagore, son of our poet Rabindra Nath, and Mr. Santosh Chandra Mazumdar from Bengal and another Mr. B. D. Pande from Kumaon were on their way to America *via* Japan. On the first day of their medical examination at Yokohama, only Mr. B. D. Pande was allowed to go, this youngman comes from the hilly parts of the U. P. and is as strong as one should be in his prime of youth. He alone started for America, and as San Francisco was in ruins at that time, his destination was the port of Seatle. Now Messrs. Tagore and Mazumdar were allowed after another examination. Mr. B. D. Pande went so far so Seatle but allowed to land there ground of medical unfitness. He was all right as regards his health on board the ship off Seat applications and entreaties to the authorities and other endeavours were of no avail, and he was compelled to sail back for Japan. He is now again in our minds as jolly and healthy as before. We have not yet received any information about Mr. Tagore and his companion. May they safely land at their destination.

Another Bengalee student Mr. P. Bose who came here by the end of May bound for America was compelled to waste his precious time, being disallowed by the medical authorities, on the first day.

I send these informations, being

requested by the Indian students in Japan, for the knowledge of students intending to go to America.

INDIAN STUDENTS ABROAD SENT BY THE ASSOCIATION FOR THE ADVANCEMENT OF SCIENTIFIC AND INDUSTRIAL EDUCATION OF INDIANS.

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tement of progress made 1905.

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1. Mr. Kali Charan Nandi.—Has been taken in as a research scholar of the Glasgow University, the senate of which has passed a resolution allowing him to appear for the D. Sc. Examination next year. He has also joined a factory of Electric works where he is making good progress and is spoken of in the following eulogistic terms by his employers Messrs. Telford Gier and Mackie:—

He (Mr. Nandi) is a hard-working anxious fellow, always up to time—keen to learn and to know everything. As good as any Euro-

2. Mr. Dhirendra Kumar Ray. —Has joined a firm of Pharmaceutical chemists and is attending classes at the Royal public school of Pharmacy, Edinburgh and is studying for the Ph. C. Examination.

3. Mr. L. M. Sen.—Has joined the Glasgow University to learn Mechanical Engineering, where he is looked upon with special favor and is very kindly treated by the professor. He studied Chemistry for the last six months and passed in the subject. He will go up for the B. Sc. next year.

4. Mr. Gopal Chandra Sen.— Is now in Leeds where he has joined the Dyeing Department and the professor, who is a famous man in Tinctorial Chemistry says that he will be able to send Mr. Sen back as a specialist in Dyeing Mr. Sen has become successfu in getting entry into a Dyeing Factory.

5. Mr. Jatindra Kumar Das Gupta.—Has joined a large Engineering Shop in Paisely, Scotland.

6. Mr. B. A. Taher.—Has joined the Factory of the Continenta Leather Company at Wilmington Delaware U. S. A. Notwithstanding the great influence of the Y M. C. A. on his behalf he coul not get into any leather factor except as a common labourer.

7. Mr. Indu Bhushan De.—Is now in Cornell University. U. S. A. where he has entered the Agricultural Department and has been permitted to go up for the Master's degree next year without taking the ordinary degree first.

8. Mr. Santi Pada Gupta.—Has got himself admitted into the ceramic Department of the higher Technological College, Tokyo Japan.

9. Mr. Jagannath Sahai.—Has secured a seat in the Weaving and Dyeing Department of the Technological College, Tokyo Japan.

10. Mr. Lakshetwar Barathakur.—Has got himself admitted in the Imperial Agricultural College at Sapporo in Hokaido (northern part of Japan).

11. Mr. Ananda Prokash Ghose.—Has finished practical and theoretical courses on the manufacture of Matches in Tokyo and has joined a large Match Manufactory in Kobe. (Since returned to India).

12. Kumar Amindra Narain.—Has joined a Factory in Tokyo to learn the art of manufacturing Pencils and will soon join another to learn the manufacture of Matches.

13. Mr. Indu Bhusan Vidyanta.—Has learned the manufacture of Matches and Soap.

14. Mr. Mohesh Chandra Ray.—Is in Tokyo University and has joined the Sericulture Department and during the long vacations he will learn the manufacture of Button and Horncomb.

15. Mr. Purna Chandra Ray.—Has learned the manufacture of Matches and Soap. He has now joined a large Match Manufactory at Kobe Japan.

16. Mr. Jogendra Prosad Bose.—Is learning the manufacture of Soap in a Factory in Japan.

17. Mr. N. K. Banerji.—Has left Japan for America.

Mr. Satya Sunder Deb been sent to Japan 2½ years by the Society of Theists latterly got a scholarship f[illegible] Association, has returne[illegible] qualified after a full course of study in College and in factories of porcelain. He has already secured a good appointment in a Pottery Work.

The professors and manufacturers of Great Britain have shown special favour to our students as will appear from the above. In Japan also it has been through the goodness of the British consul, Viscount Nagaoka, Boarn Kanda as well as the secretaries of the Y. M. C. A. and the Indo-Japanese Association that our boys have been able to join Colleges and Factories in perference to students of other nationalities.

The thanks of the Association are due to Mr. Hamilton, Mr. Campbell, Mr. Potdar of the Indo-Japanese Association, Mr. Helm of the Y. M. C. A. of Tokyo and the Y. M. C. A. of New York for acting as guardians of our students.

LIST OF SCHOLARS ABROAD
1906.

America.

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ish Chandra Guha, agriculture.

ogendra Narain Chakra-…, agriculture.

(3) Bepin Behari Law, agriculture.

(4) Rathindra Nath Tagore, agriculture.

(5) Santosh Chandra Mazumdar, agriculture.

(6) Dinendra Nath Tagore, agriculture.

(7) Abani Mohun Ghose, Electrical Engineering.

(8) Priyavandhu Sen Gupta, Homeopathic Pharmacy.

England.

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(1) D. C. Nag, Hardware.

(2) Muhamed Ismail, Mechanical Engineering.

(3) Purna Chandra Ganguli, Mechanical Engineering.

(4) Atul Chandra Sen, Leather manufacture (Leeds).

(5) Sarat Sashi Mullik, Glassware (Glasgow).

(6) J. C. Sett, Mechanical Engineering (Glasgow).

France.

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(1) Lalitmohan Das, agriculture.

(2) Kshirodechandra Sen, Essence and Pomades.

Germany.

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(1) Upendranath Chowdhury, sugar refining.

(2) Lalitmohan Bhadra, Enamel.

Japan.

(1) Kailash Chandra Bharatkar, Mechanical Engineering.

*(2) Sudha Lal Mukerjee, Mechanical Engineering.

(3) Probodh Chandra Bose, Mechanical Engineering.

(4) Rajib Lochun Datta, Hardware.

(5) Ansaruddin Ahmed, Leather manufacture

(6) Satis Chandra Bose, Agriculture.

(7) Ambica Charan Ghose, Tobacco culture, cigars and cigarettes.

(8) Jyotish Chandra Das Gupta, Ceramics.

(9) Surendra Mohun Bose, Applied chemistry.

*(10) Suresh Chandra Banerjee, Applied chemistry.

(11) Dinesh Chandra Mazumdar, Rubber.

(12) Birajmohun Chatterjee, Spinning and weaving.

(13) Raimohan Datta, Spinning and weaving.

(14) Manmatha Nath Ghose, Soap and pencil.

(15) K. P. Chatterjee, ditto

(16) Bhola Nath Pande, Soap and candles.

*(17) Nagendra Nath Mazumdar, Soap and candles.

*(18) Mahim Chandra Sen, Soap and matches.

(19) Mohini Mohan Chakrabarti, Buttons and horncombs.

(20) Saradaranjan Sen, Combs and hornworks.

(21) Khagendra Chandra Das. Hosiery.

(22) Upendra Chandra Mukherjee, Clocks and watches.

(23) Srish Chandra Guha, Tin and lacqur works.

(24) Promotho Nath Dey Chowdhu

(25) Mohan Lal Burman.

SOME BOOKS AND PAPERS ON TECHNICAL EDUCATION.

A long series of books relating to applied Science and chemistry containing innumerable recipes and formulæ for various kinds of industries and manufactures, and mechanical engineering have been published from time to time, by E. & F. N. Spon,

London : 16, Charing Cross
New york : 446, Broome Street
out of which the following may be specially mentioned :

* Gone under the guardianship of the Association.

(1) Spon's Dictionary of Engineering, Civil, Mechanical, Military, Naval—Complete in 3 volumes cloth £5. 5*s.* Half-morocco £6. 12*s.*

(2) Supplement to the same £. 2.

(Each subject in it is treated in a comprehensive way without repeating the information already included in the body of the work).

(3) Spons' Encyclopædia of Industrial arts, manufactures and Commercial Products. In 5 Divisions, cloth, price, 13*s.* 6*d.* each.

(4) "Workshop Receipts" Conning some 500 pages of formu-l and receipes for innumerable ınufactures.

There is (1) a series of Practical ınuals (illustrated), cloth, 1*s.* t each, called the "work Hand-ɔks" and (2) "Mechanics' Manuals" edited by Paul N. Hasluck, illustrated, 6*d.* net each,

(3) A magazine called "work—or the illustrated Journal of Handicrafts" all published by Cassell and company, Ld., La Belle Sauvage, London, E.C., which will prove interesting and instructive to students of mechanical Enginering or applied science.

Mr. CARNEGIE'S ADVICE.

Young Men and a Business Career.

There is only one royal road to success for peoples. They have to depend upon themselves. I mean, democracy must help to save itself. It must not depend upon either class trusts or millionaire trusts as a panacea. The trust of the classes or castes has failed. I am the very reverse of 'pessimistic' yet, if I thought democracy was a failure, I should conclude that there is no hope for humanity.

Millionaires have their uses but in their charity trusts they should use their surplus wealth for the highest good of the people. If they do that they have a *raison d'etre*, and they show that they are a far more noble institution than feudalism. I have scant respect for the millionaire who waits until the Angel of Death has knocked at his door before he gives of his wealth. He cannot take it with him. I believe some millionaires would if they could."

"What is better than a Millionaire Trust?" Mr. Carnegie was asked.

"Education. But let me exaplain. A young man intended for a busi-

ness career is better without a university education. I speak of the young man who has to make his way in the world. The youth born to wealth does not interest me. He amounts to nothing, any way. The basketful of bonds kills his usefulness. The man who has to make his own way should go to work at eighteen. The workshop is the best university. The man who spends four years in the university never catches up with the other. His set ways and his pretentious superiority are hindrances. I prefer the man who puts on his pumps and goes down in the mines rather than he who stays in the lecture hall and toys with samples. The university is all right for those preparing for the professions except the ministry."

"Give me an example of what you mean by the right sort of education?" asked the correspondent.

"I prefer to give you an example of the wrong sort of education. Why should English sailors have to learn Greek and Latin? I mean, of course, young men preparing for a career in the Navy. Do you suppose that the study of Helen of Troy makes them better sea dogs? Reading Horace on his Cynthia at his Sabine farm is a poor preparation for saving the empire of the seas. They may as well spend their time pouring over the memoirs of Fanny Hill or reading the life of Sophie Arnold, or of any other courtesan of history. Besides, after a year or two all they can say is "agricola arat."

PART VIII.

Supplemental Miscellany.

SMALL INDUSTRIES.

(*By R. M. Kelkar.*)

It is a question worth consideration, whether and, if any, knowledge of technical industries could be given in the elementary schools.

2. In the fifth and sixth vernacular standards and also from 5th to 7th standards of English schools, boys are generally above 12 years and some training can be commenced with those students.

3. This rudimentary knowledge may be considered as a foundation of the future technical instruction, to create a love and taste among the students. In England and much more so in continental countries, this sort of taste is created. Those who have any chance to come in contact with European gentlemen of high class, do know that not only they are well up in literary education but they know some art or another. The knowledge and practice of these arts give, besides utility, some bodily exercise. Instances of gentlemen from civil, and political aud military services may be given to any extent.

4. The attention of students there is drawn to these things from their childhood. One can see from a lesson in the English Royal Reader No. I, in which an account appears of an aunt sending present of seeds and spade and little boys growing flower plants and a similar lesson of two girls washing the clothes of their dolls and some others. If one goes to a shop of European toys, there he may find small spinning wheels, wind mills, water wheels and a number of such other things. Boxes of small carpentry tools can be had in number, which shows that these tools are handled by small boys to make a progress in the art. One can find positive evidence of a practical training of students in the different courses of kindergarten system.

5. Let us now see what can be done here. I think some knowledge of practical drawing is in the first place necessary for any industrial art. It can be considered as the foundation of every art. I would also consider necessary the rudimentary knowledge of mechanics and chemistry.

6. Next to this I would consider bamboo and wire works as very easy and fit to be introduced. I remember to have read some years back in the "Bombay Gazette" that in Japan these industries are taught in the elementary schools. In the bazars, we get several articles from Japan and China, made of bamboo, which can be substituted or replaced by Indian made articles. Instead of costly furniture or drawing room decorations or other articles of utility cheap bamboo articles can be introduced by people of middle and poor classes. To increase the comfort of humanity, with as little money as possible should be the object of all our reforms. Some of these articles of bamboo can be made with a big sharp knife by any man or boy of ordinary intelligence. For a few others a little training or practical attempt and observation of intelligent students or amateurs, will enable them to prepare these articles. The pioneer workers may keep good many such articles made here or abroad before them as patterns and then direct their attempts for copying them. Some such articles are made by upper India people.

7. I would mention a few bamboo made articles which can be selected for copy or preparation. First picture or looking glass frames, 2 fans, 3 chairs or easy chairs, 4 horses for keeping clothes hats and turbans etc., 5 curtains with clothes or without, 7 stands for clocks and watches, 8 waste paper baskets, 9 tables for keeping books and other articles, 10 ornamental baskets for flowers etc., and many other articles samples of which can be procured in China or Japan shops or with travelling agents.

8. Articles of wire also can be made with mere tongs and scissors used by goldsmiths or blacksmiths for small purposes such as 2 baskets, 3 stands for stationery, stands for keeping paper and pencils and stationery articles.

9. Fret saw work. This work can be done with a small machine and small blades. Working designs published in Europe and America can be had or can be drawn up and lithographed in India.

10. Carpentry.–Carpenters' work can be taught as useful to any man in daily life either belonging to any profession or layman.

11. Brush-making. Brushes are made very easily and the work can pay, if taught to do it economically? With some help of small bent saw, circular saw and drill or

even with ordinary carpentry tools this work can be made.

12. Weaving of "Nabar," "Nar ri" and Tapes, etc. All these can be done easily and would give a little employment as all these articles can be used at home or have a sale in the Bazar. Besides, that would be a sort of preparatory teaching to learn weaving on a reasonable scale.

13. Electoro-plating with silver, nickel, copper or gold. This can be done with a cheap earthen battery made by ordinary potter or at home with necessary chemicals and material.

14. Button-making of mother of pearls, mother of cocoa and of wood. This can be done either with a small machine or even by hand-tools.

15. Poker-work. This work can be done with a small machine. Ornamental carving can be made by burning with the aid of the machine and spirit on wood, ivory leather or cloth. The work looks exceedingly well at least for some years.

16. Block printing in black colours on cloth. This can be done easily and can steady hand and eyes of the workers. Cloths for women, handkerchiefs, table-cloths can be used on a large scale prepared with this sort of method.

17. Nibs, holders and wicks of lamps and some other articles can be made on a machinery which would not cost a very large amount.

18. The industrial knowledge can be imparted to the students during recess hours of school days and 3 hours on Saturday and 4 and 5 hours on Sundays. Arrangements can be made to teach these subjects very easily. In the 'Baroda State where there are manual training classes, they are exempted from the Geography and History in the examinations of the vernacular schools to which alone these classes are added for the present.

19. In Guzarat the carpenters get a recess time about an hour and half at the noon. I do not know whether there is a similar custom in Deccan. If there is, it would be well if the services of carpenters are secured to teach the students during that time for they will cost reasonably less if such an arrangement is made.

—*Maharatta.*

SWADESHI INDUSTRIES.

(Max in the Capital.)

An increased daily supply of saltwater fish is one of the things which Calcutta badly requires. The

difficulty is to get the industry efficiently orgainised and put into working order. It requires sufficient capital, with brains, experienced and orgainising power at its head. The fish are near at hand in inexhaustible supply. The problem is how to catch them and bring them to market every morning. I took a run down to port Canning last Saturday afternoon to have a look at the place, and it struck me at once (I find it has struck others before) that here is an ideal fishing port for Calcutta. The Mutla swarms with good edible fish of the salt water variety, and if a small fleet of steam-trawlers under capable management were organised, then with the railway station at the water side as it now is, a special fish train could easily land its freight in Calcutta within a couple of hours.

A small intermittent supply of a few boxes at a time does now come from Canning, but thess are but a small sample of what might easily be developed into a very large daily industry of a most profitable kind. I would strongly recommend this scheme to my Swadeshi friends as one which would add to the food supply of the people and to their own wealth, but then they will look at nothing less than a cotton mill, which would probably disperse their shareholders' money. However, there is such a promise of a good return to those who intelligently invest in the enterprise, that it will be taken up before long. I am astonished that the Port Canning Company themselves have not developed this fishing industry, but the directors (native gentlemen who live on the other side of India) seem to be quite pleased to collect in their Zemindari rent and nothing else.

Fishcuring could easily be started also at Canning, and in that case the name of the station would have a double significance. Aberdeen is one of the largest centres of the Steam-Trawling industry on the east coast of Scotland, and the vessels built there for fishing are probably the finest and the best equipped to be found any where. The Aberdeenians are also full of commercial enterprise. I am informed that an Aberdeen Company have a fleet of steam-trawlers exploiting certain fishing grounds near the Cape in South Africa. Perhaps this same Company might exploit the Mutla, if spot enterprise is wanting. Or, probably, they might supply half the capital required in steam trawlers plus expert experience in the handling of them if the other half of the capital, were raised in India. Anyhow this Mutla fishing enterprise is well worthy of consideration. There is fish in abundance, and a big market within one or two hours

journey by rail of the jetty where catches could be landed.

The Swadeshi industry of brick making is now and will likely be for some time to come in an extremely flourishing condition. The building of houses, jute mills, ware house, &c., &c., has created such an enormous demand for bricks that prices have advanced to Rs. 16 and upwards per 1,000. The Port Commissioners who are large consumers of bricks for their various operations are tired of paying Rs. 16, and are to be their own brickmakers in future, having just acquired land on the river bank for that purpose. They will be able to make bricks for at least half the sum they are now paying and that means a saving of Rs. 80,000 on every hundred lakhs of bricks. Some of the Jute Mills are also making their own bricks which is perhaps at the moment the only profitable thing they are engaged at.

Another Swadeshi which is bound to take root in India at some time or other is the extraction of Nitrogen from the air in the form of Nitrite or Nitrate. The corn supplies of the world depend on the ample supply of nitrates to the soil and as the natural reserves in the shape of Chili saltpetre are getting rapidly depleted we will have to lay the surrounding air under tribute to supply the necessary fertiliser. Sir William Crookes started the idea some eight years ago at Bristol, and at that time stated, as the result of experiments, that 14,000 Board of Trade units of electricity would yield the equivalent of one ton of Nitrate of Soda.

Since then Chemsits have been busy at work endeavouring to find out a process whereby the manufacture of nitrates from the atmosphere could be made a commercial success. It has been reserved for two Norwegian scientists Messrs. Birkeland and Eyde, to show the way in which it may be sovled by the use of electricity. In place of using a large number of small sparkling arcs, they make use of one large flame arc produced by alernating currents of 3,000 to 4,000 volts pressure, this flame being made to take the form of a disc, 4 to 5 ft, in diameter, by a special method, the details of which were discovered by Prof. Birkeland by accident, as many great discoverieshave been. Ordinary air is forced through this disc of roaring flame, and emerges charged with nitrous gases. This charged air is then quickly removed from the vicininty of the flame and is subjected to chemical treatment in order to obtain the gases in the form of nitrate of lime.

When I first drew attention to the Crocodile and Alligator Skin Industry as worthy of attention as a genuine Swadeshi enterprise, the idea seemed to get abroad that I was poking fun at the more blatant and wind-baggy order of the spurious patriots and was inviting them to commit the happy despatch by entering into the saurian maw. I am glad, however, to see one after another of the newspapers in India have now begun to take the matter, up seriously. A new industry like this requires a beginning, and the first thing to do so is to collect all the information possible regarding mode of capture, preparation of the skin for the market, and not least where to find a ready market for the skins, and the prices obtainable for the different sizes and grades. As I mentioned before, the United States is the largest market for these skins (Europe may be left out of account altogether at present), and I am now engaged in collecting all the information possible that will be helpful to those who are starting the new industry in India. In America last year no fewer than 280,000 alligator and crocodile hides passed through the market.

I may mention parenthetically in passing that independently altogether of the skin industry there is a considerable business done in live saurians. There are people in Europe and America who are fond of strange pets, and young live alligators are in demand by them. Public and private menageries also buy them in all stages of growth and of course zoological gardens everywhere are amongst the customers. The demand for these young pets and for the larger specimens is so constant that alligator-farming is now an industry by itself in the United States. An alligator farm for the purpose of rearing youngsters for export would be a very easy matter in the neighbourhood of Calcutta. The farm could be stocked at little expense. An alligator farmer in Texas has one department for rearing the young ones from the eggs. Knowledge, however, of every detail of the business is absolutely necessary before a beginner can make a success of it.

PESHAWAR FRUIT TRADE DEVELOPMEMT.

The total area of the fruit orchards in the North-West Frontier Province is 4,000 acres of which no less than 2,700 acres are situated in the Peshawar district. The annual exports of fruit from Peshawar are therefore considerable, totalling up to 3,130 tons, which is sent to places as far distant as Rangoon. A

special fruit van is despatched from Peshawar to Howrah during the months of September, October and November which is the height of the season; and this van conveys about 5,000 maunds per month. It is considered that the trade in fruit is capable of considerable development if special fruit vans were constructed and a proper system of grading and packing the fruit introduced; at present there is no proper system, and this matter will receive attention from the recently created Department of Agriculture of the North-West Frontier Province with its experimental farm at Peshawar.

ARABIAN DATE TREES IN THE PUNJAB.

The experiment of introducing a superior kind of date in the Punjab does not appear unfortunately to have met with any remarkable success. Though these experiments have been tried for nearly a couple of decades and seeds and off-sets of Arabian dates have been largely imported and distributed among the cultivators, no serious attempt has yet been made to train them to the Arabian methods of cultivation. Watering, manuring and careful watching are more than essential to date cultivation, and these seem to have been very much neglected in the Punjab. We hope the Agricultural Department will carefully guide the operations of the cultivators in these lines.

FRUIT FARM AT SHILLONG.

Experiments have been made from time to time in the cultivation of fruit in the fruit farm at Shillong, and during last year a severe frost did some damage to the trees and a large number suffered from the ravages of insects. It is considered too early yet to indicate the results but so far the best progress has been shewn by pear trees from Saharanpur and by the English cherry, fig, peach and almond trees. In connection with the propagation of fruit trees with a view to their distribution amongst the cultivators, successful experiments were made in grafting the English apple and pear on the indigenous stocks and in grafting English grapes on a wild native stock. Special attention has also been given to popularising the cultivation of rhubarb and asparagus which have been found to do well at Shillong, and with this object seedlings and seed were distributed and bulletins issued in Khasia. A tropical plantation has also been started on the southern slopes of the Khasia Hills

for making experiments in certain tropical products. A number of spices, fruits, drugs and other products are under trial but it is too early yet to speak of results as it will be several years before the trees begin to bear fruit. They appear at present to be doing well and some of the papaya and banana trees have flowered and are bearing fruit. Two varieties of caravonica cotton trees were grown and a sample of lint obtained from No. 2 variety was valued at a higher rate than is obtained for Assam cotton. Some of the cotton trees are now in vigorous growth. Experiments were also made with 14 varieties of potatoes at the Fruit Garden at Shillong and the best results (292 maunds per acre) were obtained from stock of magnum bonum (282 maunds per acre.) It was found that the varieties grown from newly imported seed were the most free from disease, but the general results of the experiments confirm the experience already gained that owing to the infectious atmosphere of the hills any variety, if grown for several years, will become infected and more diseased every year. Several spraying experiments were tried and these resulted in an increased outturn per acre, enabling the plants for a certain time at any rate to withstand the effects of blight. The result of some manure experiments was to shew the superiority of oil cake to a new form of potato manure sold by Messrs. Waldie and Co., which was also tried. Three varieties of American sweet potatoes were sown and did well, but proved in no respect superior to the country variety of sweet potatoes. A large quantity of seed potatoes were supplied from the Farm to correspondents.

MANURE FOR PADDY CULTIVATION.

Result of Government Experiments.

It is interesting to note that a series of experiments have recently been carried out with bonemeal and saltpetre as manures for paddy cultivation and that they have proved an unqualified success. The Director of Agriculture, Bengal, is to be congratulated on the success of the venture, as it was under his directions the experiments were tried in no less than thirteen villages with the result that the yield from each bigha of land was considerably increased. The increase per bigha is estimated at 4 maunds and ten seers, and the value of increase per bigha is com-

puted at Rs. 8-8. These results would appear fully sufficient to justify the extensive adoption of this manure, as it is a most significant fact that its application has been extremely profitable. It is of the utmost importance, therefore, in the interests of the country that every effort should be put forward to encourage the cultivators in all rice producing districts in India to make an extensive use of this manure. It is a well known fact, however, that hitherto an extensive export trade has been carried on in both trese products which are indigenous to India, and it is a matter for consideration in the interest of the country, now that their utility as a manure has been discovered whether restrictions should not be imposed on their exportation. As this is a question affecting the commerce of the country, it is possible the Bengal Chamber ot Commerce will interest themselves in the matter and approach the local Government with a view to safeguarding the extensive exportation of these products which recent experiments have proved to be so useful a factor in paddy cultivation.

(Vide article on bonemeal p. 25 and on Saltpetre p. 136, ante).

FERTILISERS FOR CROPS.

A Kashmir Project.

Lahore, Nov. 1906.

The numerous tasks, to which the hitherto unharnessed torrent of the river Jhelum, in the Kashmir hills, is to be embondaged, have already been enumerated and described. The new idea is to utilise some of the superabundant power for the manufacture of nitrate of lime as a fertiliser for the wheat fields of Northern India.

Only two raw materials are required for the manufacture of nitrate of lime, namely air which is free and limestone, which is cheap or dear according as it abounds or is scarce locally. The third essential, as already indicated is an abundance of cheap electrical power in Kashmir. As has been explained previously, in regard to the hydroelectric power installation, for a stretch of eighty miles along the river Jhelum, a power station could, if required, be erected at every sixth milestone, and each such power station would yield 100,000 horse-power. Thus the supply of electrical energy may [illegible] regarded as practically unlimited [illegible]d fortunately it happens that the [illegible]shmir hills in many places consist [illegible]tirely of limestone.

In addition there will be the proposed Kashmir electric railway, linking the Kashmir hills with the Punjab plains, and on this railway the nitrate of lime to be manufactured in Kashmir could be carried at a cheap rate.

Incidentally the carriage of this manure in immense quantities would add largely to the earnings of the railway. In short, the whole combination of circumstances seems peculiarly favourable to the Kashmir State.

At present the Punjab cultivator cannot afford to put manure on his fields, except where the value of the crop is high, as in the case of sugarcane and cotton. Ordinary manure cannot be had cheaply, yet it is well known that the value of the Indian wheat crops is much below what it might be if a suitable fertiliser were available at a low price. Possibly the outturn could be doubled, as the present average outturn of wheat in India on unmanured irrigated lands is about 14 maunds per acre. In Europe wherever there is a plentiful use of manure, the outturn of wheat is as high as 40 maunds per acre. An Indian acre which at present yields Rs. 30 might thus perhaps be made to yield Rs. 80. The area of wheat annually irrigated by the Punjab canals alone is at present 2,000,000 acres, and the new irrigation projects will increase this figure considerably. In the United Provinces the area of irrigated wheat is 800,000 acres.

That is to say nearly 3,000,000 acres of wheat land are within reachable distance of the proposed nitrate of lime factory in Kashmir. If the outturn of that area could be about doubled by the use of manure the gain to the two provinces (not counting the cost of the manure for the moment) would be twelve crores of rupees annually.

Let it be supposed that only 1,000,000 acres would be supplied in any single year, the profit to the Kashmir Durbar on each horse-power of electricity taken up would be As. 15. One horse-power would produce 20 maunds of nitrate of lime. A million acres would require two million maunds at two maunds to the acre and the profit to Kashmir would therefore be 15 lakhs per annum. This does not include the profit accruing to the Kashmir railway by the carriage of the nitrate.

Nitrate in Kashmir.—The result of the investigation into the extent of the nitrate deposits in Kashmir is being awaited, with some interest, since, if the mineral can be got into at a reasonable figure, the boon conferred on all classes of cultivators will be immense. Applied to the irrigated paddock on the Jhelum and Chenab canal systems, it would treble the yield

of fodder, while those who are awakening to the importance of cotton and other fibre propagation would find that cheap nitrate would ensure their success.

There is another aspect from which the discovery must be viewed, which is that the geological formation of the valley and surrounding country may possibly prove identical with other and more accessible places along the Empire's northern boundary, possibly unveiling other deposits, and as the work of Indian Geological Survey has been pretty well completed, one of the officers might be deputed to undertake an examination in the present cold weather of such places as the basin of the Lohit Manipur, and that region where the so-called borax lake is supposed to exist north of the Manaas opposite Dewangiri.

The process has been undergoing gradual industrial development in Norway since 1903, until now a Company has been formed to further operations. A large number of German and Norwegian banks are lending their support to the new undertaking and a capital of £375,000 is being raised. The factory at Notodden has been taken over by the new Company, and extension of works until it is in a position to utilise 30,000 h. p., are contemplated. The annual output of Calcium Nitrate by this Company when the works of Notodden have attained their full development is estimated at 20,000 tons.

Dr. Otto Witt, who has investigated the process, states that the equivalent of half a ton of nitric acid (100 per cent.) can be produced per k. w. and that at Nottoden, where the water power can be very cheaply developed, this amount of electricity costs only 16*s*. The value of the lime required for operating the process is not great, when compared with the value of the final product, and it is expected that the new fertiliser will easily compete in price with Chili saltpetre for agricultural purposes.

MELTED ICE TO PRODUCE ELECTRICITY.

Now the ice of the Alps is to furnish light and power to an Italian city, and for the second time science has conquered easily the great barrier that loomed before Hannibal and Napoleon. Having gone through the Alps by way of the Simplon tunnel, modern invention now will transform the beauty of the mountains into utility. At the foot of a snow-clad peak on the

southern slope is a water-fall, the torrent of which is fed from glaciers. Forty miles away is Turin, with an antiquated system of lighting. The lesson taught by our own Niagara was learned easily by the Turini. A great hydraulic power plant is being erected in the gorge, and the waterfall will generate an electric current, furnishing both light and power for the distant municipality. It is estimated that the expense of operation will be small and the cost of the current will be the minimum.

SILT MANURE.

The question of utilising hill streams for the fertilisation of land by covering it with silt has been favourably considered by the Government of India. Practical inquiries as to the feasibility of adapting the Italian plan will probably be made during the ensuing cold weather.

FARMING WITHOUT WATER.

How Science Makes Farming Succeed Without Irrigation.

Mr. J. L. Donahue, of the Scientific Farming Association of Denver, contributes an interesting article to the August number of the "World To-day" on "Farming Without Water."

He says that thousands upon thousands of acres hitherto considered worthless for general agricultural purposes are now producing excellent crops every season without the aid of irrigation—as well as orchards and shade trees.

"Many who know a great deal about farming have a very decided conviction that a great deal more moisture is necessary to produce crops in semi-arid sections of the country than Nature supplies. But the master of agricultural science knows that the problem before the farmer everywhere is not the scarcity of natural precipitation, but how to conserve the precipitation in the soil. Western men who are reclaiming semi-arid lands by means of what Nature supplies them are confident that twelve inches of annual precipitation are sufficient, if properly conserved, to produce crops.

"If the soil is cultivated carefully and intensively, it can be made to hold water within itself and carry a strange reservoir underneath the growing crop. Finely pulverising and packing the seed bed make it capable of retaining the greatest possible percentage of the moisture that falls just as a fine sponge of a certain size will hold many times

as much water as a course sponge of the same size. It is a well-known fact that water moves in the soil as it does in a lamp wick, by capillary attraction. The more deeply and the more densely the soil bed is saturated with moisture the more easily the water moves upward in the soil, just as the oil 'climbs up' a wet wick faster than it does a dry one.

"The problem of evaporation is the mightiest one before the agriculturist of semi-arid lands. The soil 'blanket' or 'mulch' is the means whereby a very dry atmosphere is prevented from drinking up the moisture from the soil too quicikly.

"The finely pulverised surface serves a two-fold purpose; it prevents the moisture from below, in large measure, from evaporating and, at the same time, keeps the surface in such condition that it readily absorbs whatever sudden showers may fall. One can illustrate the effect of this fine soil 'mulch' so far as preventing evaporation is concerned, by placing some powdered sugar on the surface of a lump of loaf sugar, and holding the latter in a tumbler of water. He will observe that the powdered sugar will remain dry even when the lump has become so thoroughly saturated that it crumbles to pieces in his hands.

"The work of seed selection being done by the Agricultural Department at Washington, by the agricultural colleges of the West, and by private individuals all over the nation, is little appreciated by the average farmer. The Department at Washington has ransacked the world for drought-resistent seeds that would thrive upon semi-arid lands. It imported from Russia, where it is grown under ten inches of rainfall, the famous 'Macaroni' or, properly called, Durum wheat. In 1901 there were produced in America one hundred thousand bushels of this wheat, and last year upwards of thirty million bushels—a large percentage of it on the semi-arid land of the West. This is a wheat that will not thrive under humid conditions. It must have a dry climate in which to develop its best qualities. It is a very common thing for Durum wheat to produce forty bushels per acre under fifteen inches of rainfall and careful cultivation.

SCIENTIFIC FARMERS AT WORK.

"Fruit and shade trees are among the very easiest things to be grown on semi-arid lands, as the United States Forestry Service

is proving in a large way in the sand hills of north-western Nebraska.

"Transformations such a the world has never witnessed in any portion of it, under any civilsed people, are now taking place on the very face of a region that a quarter of a century ago was considered a fit habitation for only the Indian and the buffalo. Cactus beds are giving way to cabbage patches, and the sage brush is being displaced by the cherry and the plum, and all this is taking place without the use of irrigation, through scientific methods of soil culture, combine with selection of seeds adapted to semi-arid conditions.

"Scientific farmers are prepared for dry seasons; for they so well succeed in conserving an excess of moisture in the soil, in seasons when precipitation is above normal as frequently happens, that when a dry season comes a fair crop, at least, is a certainty. A total failure is never known among the scientific farmers of the plains. But it requires men of clear brain and strong arm and resolute purpose to make a success of non-irrigation farming in the semi-arid regions."

"Famine Foods."—Among the articles sent as "famine foods" to the Reporter on Economic Products to the Government of India were tubers of a common jungle plant called Costus speciosus by botanists. The plant belongs to the ginger family, and the root is not unlike the ginger, only it is free from aroma, and has been found on analysis to be fairly nutritous. An "Agricultural Ledger," No. 2 of 1906, just issued, gives a full description of the plant and its qualities. It is found in many parts of India.

INDIAN CUTCH.

Nos. 2 and 3 of the "Agricultural Ledger" for the current year have been written by Mr. Hooper and published by the Reporter on Economic Products to the Government of India. The first consists of a note on the uses and value of the root of "Costus speciosus" as a food stuff, and the second is an instructive paper on the composition and trade-forms of Indian Cutch—"Acacia Catechu."

In the first paper it is shown that the Costus root is not a bad food stuff, though it contains a larger proportion of fibre than most tuberus substances used as food.

In the Ledger on "Cutch," Mr. Hooper gives an interesting summary of the manufacture, trade-forms and composition of the Indian and Burmese product, and an ana-

lytical table of the composition of most of the trade varieties, so as to form estimates of their comparative values. One is referred to the "Empress" of July 1903 for excellent illlustrations of Cutch boiling in Burma.

The trees chosen are generally about 2 to 4 feet in circumference, for in smaller ones there is little or no heart-wood. Each tree as it is felled is stripped of its bark and the heart-wood is removed and split up into small pieces. These pieces when boiled give up the Cutch in them to the water. The solution is then boiled over again nearly to dryness, and cakes made of it which are variously shaped. Cutch is in trade in many forms—:—"Khair, papri khair" and "Janakpuri khaia" are the Bengal forms, Cawnpuri—the variety which is exported from Cawnpur; the "Chana Makhan khair" of Benares: the Burmese varieties, and the four "productions" of Bombay known as the Dharwari, South Konkan, Kandesh and Suroti.

The analyses of several samples of Indian Cutch exhibited in the Indian Museum show that some are much adultered, notably the blackform obtainable at Minbu (Burma) of which one example had 49·6 per cent of ash in it, (perhaps added in Rangoon,) the Pegu No. 2 which had 28·1 per cent, and the Salpatawala No. 3, the Tela Mansarami, the Chaukhabi and the Telangir—all of the United Provinces—which had 38·3, 27·5, 26·3 and 25·7 per cent, of ash respectively. The purest forms of Indian Cutch were Surat and Janakpuri Nos. 2 and 3, with 1·6, 1·5 and 1·8 per cent. of mineral matter respectively, while among the Burma Cutches those from the W. Circle Upper Burma proved to be the best with 1·6 per cent, of ash, followed by a sample from Rangoon, by a sample of the soft Cutch of the Yaw Division and by a sample of the yellow of Pegu with 1·8 per cent. Next in order came Tharawaddy with from 1·9 to 2·5 per cent, of ash, the black Pegu with 2·1 per cent, and the Pakokku cutch.

Water among the Indian produce was least in amount in the Telangir and Salpatawala cutch where only 8 per cent. was present, and greatest in Surat and Kumaon with 14·0 and 14·1 per cent, respectively. In other samples it ranged from 9.2 per cent. up to 13·5 per cent. Of the Burmese cutches the black of Minbu, which had the higest percentage of ash, had only 7·2 per cent, of water, while all the others ranged from 8·4 to 14 per cent.

Tannin in the Pakokku "superior," and in the Tharawaddy cutch stood at 54·8 and 54·6 per cent, and was followed closely by the Pakokku "hard" (52·2 per cent.), Tharawaddy "soft" (50·2 per cent.)

and Kamrup (50·0 per cent.) A cutch from Palamau held the comparatively low figure of 29·5 per cent, of tannin; and those of the South Circle Central Provinces held 29·7 and 30·3 per cent, and the Chaukhabi 27·6 per cent. The amount of tannin ranged however, from 30·1 to 49·7 per cent.

Catechin was nil in some samples —viz. Pegu No. 2 and in the black Pegu and only 1.2 in the Palamau cutch, while it was highest in the Kumaon (U. P.) produce, having 40.8 per cent of it. This crystalline body varied in others from 1·7 to 36·8 per cent.

The kind of Cutch called "Chana Makhan" which is largely used in Benares realizes, in the Calcutta market, Rs. 40 per maund, the Cawnpuri sells for Rs. 32 per maund, the Pegu cutch for Rs. 26 per maund, the Janakpuri from Rs. 23 to Rs. 28 a maund, and the Tela for Rs. 12 per maund, while Gambier—the rival of cutch which is imported from Singapore—sells for Rs. 17 a maund.

PRICKLY PEAR AS FODDER.

The Madrass Central Agricultural Committee has just issued a useful bulletin on the subject of the use prickly pear as fodder It is a reprint of a letter from the Superintendent of Farms and is circulated for general information. It would appear, that in the United States, the use of prickly pear as fodder is not only resorted to in seasons of drought but along with other dry foods, finds a place all the year round in the forage list of many stock keepers. In this country, during the famine of 1877, a great deal was made of this plant and in many cases depots were established where cattle, we are told, were even sometimes forcibly fed on chopped cactus. The results in many cases were extremely satisfactory, though the majority of the ignorant cultivators could not be induced to feed their amimals with it, owing to the fear of diarrhoea or dysentery attacking the animals. The chemical analysis of the plant carried out at Poona and Nagpur discloses that it contains 16.96 of water, 60.64 organic matter and 29.40 of ash. A sample was sundried for four days and was found to lose 80 per cent, by weight of moisture. Feeding experiments have also been carried out; but the results have been curiously at variance. As a result of one of the experiments it was found that at the end of 32 days, three animals that were fed on prickly pear were in a thriving condition and had increased in weight. But in the case of pampered milch cattle in whose case

the food was tried, the result was a complete failure. The animals had to be starved before they would touch it, and the experiment involved so much cruelty that it was discontinued. In Deccan also the experiment was tried in the case of three small cattle and stopped as no improvement could be seen, and as the continuance would have killed the beasts. In some experments the pear was merely cleaned and sliced and in others it was boiled and steamed. From these facts, the writer comes to the conclusion that cactus in some forms is a most valuable adjunct to the fodder resources of the country, and that in times of distress it may certinly be looked upon as a most valuable auxiliary food.—"*Hindu.*"

A short illustrated paper on the preparation of prickly-pear as fodder for cattle, particularly in seasons of famine, is published in the supplement to the Madura "District Gazette." For a long time past prickly-pear has been extensively used in and about Dindigul. It is somewhat surprising that the knowledge of what is being done at Dindigul should not have yet spread to other parts of the District. Even the Tamil leaflet published in the "Gazette" contains no reference to its use at Dindigul, while it mentions its use in far off Bellary. The District Agricultural Association might take practical steps to popularise prickly-pear as fodder for cattle, especially in times of drought.

THE SOLA PLANT.

It is somewhat amusing to read the accounts of the devices resorted to in England to dodge the rays during the recent heat waves. One result has been to direct attention to Indian sola and, though in ordinary seasons the proverbial three hot days and a thunder-storm, which constitutes according to foreigners the British summer, would not give much employment for the topee, the demand in the brief hot period would be enormous. The topee is occasionally seen at the seaside but would be appreciated by all classes throughout the country, so that systematic cultivation of the plant ought to pay and pay well. The weed, for such it is, springs up spontaneously, but like many other of our jungle products has been neglected by Europeans. The sola can be compressed into bales without detriment. Sending Home the hat itself would cost too much in freight, but the manufacturers in England would experience no difficulty in moulding the head gear. It must, however, be borne in mind that it is useless to expect fancy

prices. The pith must be laid down in London or other cities at a price that can be afforded by the million.

COCOANUT OIL BUTTER.

DR. DENNER a German chemist, has been experimenting with cocoanut oil, and finds that it makes a very satisfactory article of butter. It contains 7 per cent, of soluble acid namely, butyric acid and capric or decyclic acid, which gives the butter a pleasant aroma and savour, making it taste something like a hazelnut. This butter will keep 15 or 20 days before showing any acid reaction, and sustains many of the tests of true butter, for which it is a better substitute than—Oleomargarine, and can be produced much more cheaply.

—*(Indian Review)*.

VALUE OF GOATS' MILK PROVED.

The recent remarks alleged to have been made by Dr. Freyberger about the extreme proverty of goat's milk, have attracted widespread attention. A correspondent who signs himself "Buckingham" writes to the *Science Sifting* that twenty years ago he commenced goat keeping. His daughter was reared at twelve months old up to nine years of age on goats' milk, and her constitution was healthily and vigorously built up. "Owing to removal in 1895 I reluctantly gave up goat-keeping; myself, wife, and child were soon below par by having to substitute cows milk. I am now residing in North Bucks, where I started goat-keeping again about seven months ago. Although we have been using goats' milk barely two months the change in my daughter, self, and wife is most marked in improved health and stronger power of endurance. Having more milk from one goat—nearly three quarts per day—than we require, a bottle is given to a neighbour for his consumptive daughter. The results are so marked that the father is purchasing a goat for milk. The cost of keep has averaged 3s per week for seven months."

IRON ORE IN REHAR.

The presence in certain districts in Behar of iron ore is once more attracting the attention of mining adventurers. So long ago as 1840 Captain Sage, the then Executive Engineer of the Dinapur division,

reported the richness of his division in this respect, and another authority in 1870 practically confirmed his report. In 1896 the Bengal Chamber of Commerce, in a carefully compiled report, dealt with the matter, and summarised its conclusions as follows :—"The whole railway line is notoriously rich in iron ore of a very superior description, which has been tested to yield thirty-five to seventy per cent of metal. Magnetic ore has also been found which yields seventy per cent of iron. Lime, too, is available, so that with iron, coal and lime all the elements of a great and successful employment of capital depends upon the sanction of the Government." Government are not likely to place obstacles in the way of adequately organized capital being employed in the development of so magnificent an industry.

A NEW ILLUMINANT.

The home papers announce that a new illuminant, a rival to coal-gas but much cheaper and better, is about to be placed on the market. It is produced from air and petrol, and its inventor calls it "air-gas." The apparatus which manufactures the gas has been inspected by experts, and they find that "the gas issuing from an open pipe freely into the air at once became too diluted to fire, but when allowed to pass through a burner containing an interceptor, and to issue finally from a wire gauze seat it burned with an intensely hot flame. This flame acting on the inside of an ordinary mantle, gave a light far in exess of that obtained from the ordinary coal-gas." The air of the room is not used up to produce the flame; the proper mixture being adjusted in the apparatus. "For cooking purposes the flame is not only intensely hot, but entirely free from soot and the slightest smell, savs the expert. The inventor claims that the light consumed only an infinitesimal amount of the oxygen in a room, as compared with coal-gas. The cost of the plant varies from £35 to £100, the latter kind producing 7,000 to 8,000 candle-power per hour, and the inventor estimates that 2½ gallons of petrol, at a cost of 1*s.* 10*d.*, produces an illumination equivalent to 22,248 candle-power in twelve hours. This averages about 1,000 candle-power for 1*d.* per hour. The plant is now open to public inspection at the Caledonian Works.

MOSQUITO CATCHING PLANT.

Mr. J. H. Hart F. L. S. Superintedent of the Royal Gardens in Trinidad, writes that he recently had under observation some interesting specimens of an aquatic plant collected from the Pitch Lake at La Brea. Some of the material produced peculiar pear-shaped organs at regular intervals on the stems. I observed one of these organs holding the larva of a mosquito by the tail, the larva being dead...... Later, I observed another larva just caught and securely held, which, though struggling hard, could not procure its freedom. Mr. Hart suggests that, by encouraging the growth of this plant in pools it may be possible to keep down mosquitos. The plant has been identified by Mr. Hart as belonging to the genus "Utricularia of the natural order "Lentibulariae." The organs of these plants have long been known to be capable of catching small aquatic animals.

A FIRE-RESISTING TREE.

Mr. Robert Thomson writes: "At the time of the vast conflagrations which have destroyed the great city of San Francisco, it has occurred to me that the following brief account of a fire-resisting tree will be interesting. This plant (Chaparro) is indigenous to the Republic of Columbia, with regard to which, I think, the only record of its peculiar merits is that which I have published. The London "Daily Telegraph" ten years ago (October 12, 1895) epitomized my report on the subject as follows: "It is not often a student will turn to a Foreign Office report in expectation of finding aid to Biblical exegesis, but anyone who reads Number 370 of this year will perceive that the outward and visible tokens of an unconsumed burning bush are not incompatible with the facts of nature. It has always been difficult to show how a plant could burn and yet not be consumed—a spectacle that so struck Moses that he called it " this great sight." It may be that the bush was like one of the stunted trees described in the Foreign Office report just mentioned, known as the Chaparro, which resists fire for a very long time. The branches of it burn slowly, but the trunk is practically fire proof—indeed, it appears to be a vegetable salamander, and flourishes best in the midst of great praire fires. If a long period elapses without a conflagration, the Chaparros pine away and even die, but the moment the flames burst out and roar and hiss among the vegetation then the incombustible

bushes begin to look bright and to flourish. Places reduced to sterility by incessant burning are occupied by this diminutive tree, and assume the aspect of vast systematically formed and well kept parterres. The plant to which Mr. Thomson refers is, as we learn from Mr. Holmes, a species of Rhopala. Its fire resisting property is due to the abundance of crystals of mineral matter which it contains in its bark.

PLANTS THAT EAT INSECTS.

That carnivorous plants exist is a very well-known fact. Insects which alight on these plants are immediately cut in a net of stickly tentacles, and are soon reduced to a pulp and digested. Yes; digested is the exact expression, although it sounds peculiar. There is some reason for this; it is the plant's way of procuring a supply of nitrogen. But in Canada there is a certain kind of asclepias, or swallow-wort, which kills insects not for food, but apparently out of sheer cruelty. It is a climbing plant, which people train to run over arbours and similar places. It begins to bloom in August, and its perfume attracts crowds of insects of the most varied species. No sooner have they plunged their proboscis into the sweet scented corolla than they are seized by the hard-toothed stamens of the plant and held in a vice-like grip until they are dead. A few of the larger insects manage to escape in a somewhat mutilated condition, but the more feeble insects invariably succumb. There is apparently no reason for this conduct. Evolutionists tell us that the scent of the flowers is generally to attract insects in order to insure fertilisation; and this makes the plant's action all the more difficult of explanation.

NEW INDUSTRY SUGGESTED. OSTIRICH FARMING IN INDIA.

In a report to the Bureau of Muanfactures Department of Commerce and Labour, Washington, Mr. William H. Michael, the American Consul-General at Calcutta, states that the subject of ostrich farming is receiving considerable attention from those deeply interested in the development of India.

He says that there are millions of acres of land in India well suited for ostrich farming, and the soil and climate of these vast tracts are as well adapted for this husbandry as those of Africa or Egypt.

Ostrich farms could be started on the edge of the Indian desert, in Sind, and in Baluchistan, which are at present poor and unproductive because of barren soils and scant and irregular rains, whereas the tracts would suit the birds. It would be hard to exaggerate the benefits that would result from the introduction of the new industry. The farming could be undertaken by either, European or native capitalists, who would have no difficulty in engaging the services of trained men at the same time that they purchased their ostrich chicks or eggs.

ALLIGATOR FARMING.

The great possibilities of alligator farming in India are further emphasised by an article in the 'County Gentleman' which says:—The magnitude of the industrial demand for the skin of the alligator may be adequately realised from the fact that in a single decade, from 1890 to 1900, according to the United States Fish Commissions, no fewer than three million alligators were killed in the State of Florida alone. If the neighbouring states where the animal is to be found are included, it is estimated that during the ten years named, over five million alligators perished. This great host of saurians was slaughtered for the value of the hides. And to-day the hide of the alligator is still increasing in value.

THE CROCODILE INDUSTRY.

Crocodile hunting is a favourite and exciting pastime in several parts of the world, where these big saurians are abundant. The sport is by no means unknown in India, as will be seen from a reference made lower down to a typical crocodile hunt in Southern India. So many people now-a-days are on the look-out for new and profitable enterprises with a dash of romance about them that it is strange nobody has thought of crocodile hunting in India as a pursuit in which business and pleasure, pastime and profit, might be blended in well-balanced proportions. The leather of the American "mugger" or caiman has long been turned to a variety of commercial uses, being excellent for ladies' hand-bags and other such fancy articles. The hide of the Indian crocodile was submitted some years ago to a leading London firm, which deals largely in American alligator leather, but the firm pronounced an adverse

opinion on the merits of the Indian skin for such high class work as above referred to. But surely, if the hide of the Indian crocodile will not suit for high class fancy work, it might be made to do for lots of other things, and perhaps, its price would be in its favour, seeing that in so many parts of India crocodiles are simply innumerable and are to be had for the mere trouble of shooting or snaring them. In parts of the West Coast, where the rivers and lagoons swarm with these reptiles, thousands of crocodiles may be seen at times high up on the banks, basking lazily in the sun. Moreover, the Indian crocodile has a monetary value for other reasons than the possession of a hide. It may not be generally known that crocodiles and alligators, especially the young, are to an appreciable extent in demand in the United Kingdom and on the Continent among those classes of amateur naturalists and private menagerie keepers—and their number tends to increase steadily—who have a special penchant for rearing uncommon pets. Animal dealers in London charge ordinarily 10s. for a young alligator about a foot long, while larger sizes are dearer, 30s. or £2 being the usual price of an alligator about two feet long. Crocodiles are much more expensive, small ones being worth 25s. or more in the London market. It may be worth while, therefore, to establish a business in the export of young Indian crocodiles, and this ought not to be at all difficult, for the mother crocodile can scarcely be described as a careful parent. Given a steady and constant demand for baby crocodiles, there is no reason also why crocodile farming should not be systematically undertaken. We have heard of oyster farms, snail farms, sponge farms, and even snake farms, so there is no reason why crocodile farming should not be attended with success.

A WEATHER PROPHET PLANT.

Professor Nowack, otherwise Baron de Fridland, of Vienna, claims to have found a plant which as a weather prophet is superior to any combination of meteorological instruments. It will, he asserts, foretell rainy, foggy, or fine weather from two to seven days in advance. It will also give warning of earthquakes. As regard its seeds at least, this plant is familiar, for these form those objects known commonly as "crab's-eyes," which are to be found in the possession of so many people who collect miscellaneous objects of natural history. These "crab's-eyes," of

a brillant scarlet tipped with black, are the seeds of the Abrus precatorius or jequirity. Professor Nowack has arrived in this country with a large number of his weather plants, Abrus precatorius, to endeavour again to convince our meteorologists of its utility. For some seventeen years ago, Professor Nowack made a previous attempt to do so. His plants were put to the test of a searching inquiry at the Jodrell Laboratory, Kew, under the direction of Dr. F. Oliver and Mr. D. Oliver. Professor Nowack, observing his plants, gave his forecasts, and these were rigidly compared with the actual weather. The decision was that all these trials proved was that this plant is extremely sensitive to light.

The so-called "ginger-beer plant," which, placed in a suitable solution produces gingerbeer by fermentation, is formed by the growing together of two plants, a yeast and a bacillus. They are associated in what biologists term symbiosis. Each organism in a case of this kind contributes something to the general good, and receives something from the other. In the Bulletin of the Mycological Society of France, M. L. Lutz gives an account of a similar symbiotic association of a yeast and a fungus. It is known as "Tibi," and is used in Mexico along with sugar to form a fermented liquor. M. Lutz has experimented with tibi with the object of ascertaining if the yeast could be induced to grow in symbiosis with any other bacillus than that with which it is normally associated. Various bacilli were tried, but successful growths were only obtained with one—namely, Bacillus subtilis. The two organisms formed small creamy balls which produced the fermentation. In every other case one of the organisms gradually displaced the other, so that finally only a yeast or a bacillus remained. The function of the bacillus in this plant community is said to be to form an anaerobic environment, that is, one free from oxygen, for the yeast plant.

CUTCH OR BLACK CATECHU.

One of the most interesting tanning substances of India is the black extract known as cutch.

The chief districts for manufacturing cutch are in Northern Bengal, Kumaon and the United Provinces, Bombay and Burma. In these regions the Khair tree (Acacia Catechu) grows fairly abundantly, and the aborigines have long been engaged in the industry. Trees are first selected which show a good heart-wood. This is the

covered by cutting notches into the tree with an axe. The bark and white wood are then removed, and the heart-wood is cut into small pieces or broken up in a rough mortar. The woody chips are then placed in earthen pots nearly filled with water and boiled for several hours to extract the colouring and tanning matters. The liquor is decanted into other pots and the boiling is continued in order to evaporate the water and form a soft extract. The pot is removed from the fire while hot and the contents poured out on to cloths or mats, made into mounds, and left in the shade to dry. The most important kind of cutch commercially is the Pegu or Rangoon. This form enters the market through Rangoon or Calcutta, and occurs in large solid masses sometimes weighing one hundred-weight or is made up of flat quadrangular cakes about 6 inches long and one inch in thickness. Janakpuri cutch is the pale catechu of Bengal made in Gya, Chatra and Hazaribagh, and brought into Calcutta from Patna. It is used by the Kabirajs in medicine and by Marwaris and Bengalis for chewing purposes. Tela Khair or the black cutch of Bengal, also brought from Patna, occurs in masses of a pitchlike appearance, having a shining fracture, and is the cheapest kind sold in the market, costing only Rs. 12 per maund. The Kumaon cutch is lighter in colour than that of Bengal and breaks with dull earthy fracture. It is used largely in Cawnpur and Benares where it sells at between Rs. 32 to Rs. 40 per maund. In addition to these there are prepared and mixed cutches used for domestic and medicinal purposes; one of these is called salpatawala, a tough extract mixed with red earth and wrapped in sal leaves, another is Kaya Khair, a composition of cutch, gambier, spices and flowers of the Screw Pine.

In the Calcutta markets and in fact, throughout India, there is sold a substance called papri khair or gambier imported from the Straits Settlements. This is a dried extract prepared from the leaves and branches of the plant Uncaria Gambier. It is the pale or (from its shape) cube catechu of commerce, and is sold in the shops side by side with the cutch or black catechu of the country. The similarity of the properties of these two astringents is confirmed by chemical analysis which reveals the important fact that gambier approaches in composition the Kumaon and Janakpuri cutches of Northern India.

Indian cutch is manufactured principally in Burma, and about 97 per cent. of the exports from British India are shipped from Rangoon. Within recent years there has been a decline in the Burma trade. From statistics

for the five years ending 1895-96, the average exports were 9,522 tons, and for the five years ending 1904-05 the average annual exports fell to 4,139 tons. The United Kingdom took about half and France one-sixths of the exports, while Germany, Holland, China and Ceylon took smaller quantities.

It is instructive to glance at the trade of the rival tanning material. Gambier has been exported from Singapore for several years, over 5,000 tons being sent to England from this port in 1839. In 1872 the imports into England reached 21,000 tons. Singapore exported in 1891 no less than 34,248 tons of gambier. In 1896 the amount rose to 50,000 tons and in 1897 it fell to 39,000 tons. Recent statistics show that in 1903, 32,083 tons of block and 2 823 of cube gambier were sold, and in 1905, 29,921 tons of bloek and 3,445 tons of cube. Between one and two thousand tons ot gambier from the Straits have oeen imported into India, chiefly at Calcutta, and is almost entirely consumed in the country as a masticatory with betel nut.

These figures show that gambier is now taking the lead in the market although cutch was the first of the two to enter the field as a dye, tan and medicine. The reasons for this are not far to seek. The Khair tree occupies reserved areas under the Forest Department in two or three centres in Burma, Kumaon in Northern India, and Bombay, and the manufacture is restricted owing to the limited number of tree available for felling. On the other hand, gambier is obtained from a crop, the cultivation of which can be readily extended as the demand for the manufactured article increases, and the uniformity of composition and greater out-turn of the product appeal favourably to purchasers. Notwithstanding the rivalry cutch has an established reputation and will long hold its own as an important article in the tanning industry and in domestic medicine. —*Capital.*

JAPANESE DATE PLUM IN INDIA

Visitors to Japan are much struck by a very attractive fruit, called the Persimmon, or Japanese Date Plum. There are some scores of varieties of it, all exceedingly handsome in appearance, and some of them of very delicate flavour. A few of the best varieties have been introduced into Northern India, and are being successfully cultivated at the Saharanpur gardens, whence they are being distributed to other centres. The

late Mr. Gollan made the discovery that the Japanese Date Plum could be successfully grafted on to an indigenous Kashmir species, called "Amlokh" locally, and this is now largely utilized as a stock to graft the imported species upon. The fruit is most wholesome, while it has a higher food-value than most fruits ; and this consideration alone ought to render its extensive cultivation popular.

HANDLOOM AND POWER. LOOM.

It is said that the total production of the handlooms of India is about twice that of the power looms, and, according to the census of 1901, about six million people are dependent upon the hand loom industry for a living.

MESSRS. TAT AND SONS AT SINI.

The Government of Bengal are agreeable to Messrs. Tata and Sons constructing a reservoir on the Sanjai river at Gorlkona, in the Singhbhum District, says "Indian Engineering," but as the water in the Sanjai is used for drinking and for watering cattle the permission to construct the reservoir is subject to the condition that a minimum supply of 2,000 gallons per minute is secured to the Sanjai river from the proposed reservoir.

CIGARS IN BURMA.

Although there is such a demand for cigars in Burma, not a single factory has been started in Mandalay and the industry is still carried on in its primitive form of a hundred years ago, the only plant used by the Burmese damsels being a low table, about six inches high, a pair of scissors, and a pot of stick-fast. Their skilful fingers supply the rest.

TOBACCO IN MADRAS.

The Madras Government in order to encourage the introduction of superior foreign varieties of tobacco and the conducting of experiments to find out whether any and if so which of them could be grown in the Presidency in such a way as to retain their distinguishing characteristic, viz, a good smoking

quality and light-coloured ash, have granted a lease of 150 acres of lanka (island) land in the Godavary district to a European gentleman (Mr. T. M. Barry) for experimental cultivation for five years, free of rent. The conditions of the grant are that the grantee should personally conduct the experments on the leased area, with the aid of approved and up to date appliances, in communication with the agricultural authorities and furnish the Government with all information as to progress when called upon to do so, Last year's experiments were made with Sumatra and several American varieties, but owing to climatic and other causes no satisfactory results will be secured. One of the American varieties—Kentucky white burly—tried at one of the Government agricultural stations is reported to have attracted a good deal of local attention owing to the size and weight of of the leaf.

A NEW METHOD OF PURIFYING WATER.

Worthy of trial in our Indian tanks.

Lieutenant S. R. Christophers, I. M. S. Superintendent of the King Institute of Preventive Medicine at Guindy, subjected copper sulphate to certain bacteriological tests, with a view to determine how far it is efficacious for destroying algæ in water and the bacilli of typhoid and other diseases. It must be understood first of all that there are several varieties of algae, and that the actual effect of copper sulphate upon each different species is a matter which can only be determined by experiment. Though it is claimed that *one part of copper sulphate to ten million parts of water* is enough to destroy certain kinds of algae, it would appear that others will only succumb to a solution of one of copper sulphate to two million of water. Lieutenant Christophers gives details of the action of several non-poisonous substances on the typhoid bacillus, such as tartaric acid, sodium bisulphate, nitro-hydrochloric acid, bromine, permanganate of potash, hypo-chlorite of calcium and chlorinated lime, to show that copper sulphate is not alone in its disinfectant action; but the great point in favour of the copper salts is, he says, "their comparative tastelessness and, if what is claimed be true, their harmlessness to the human organisms, even in comparatively large quantities." With a view to give due weight to the efficacy of the copper treatment he experimented with it in the following three ways

—(1) As a deterrent of the growth or destroyer of algae ; (2) as a disinfectant in pure water ; and (3) as a disinfectant where organic matter in solution is present.

By his experiments in regard to the action of copper sulphate on the growth of algae, Lieutenant Christophers was led to believe that very dilute solution of copper sulphate i.e. one part to one million parts of water, had a distinct inhibitory effect upon two species of algae, while a third remained unchanged when subjected to similar treatment. In the last case it must be noted that the water was stagnant and obviously very impure and this it would appear is an important consideration ; and the result in the last mentioned experiment caused Lieutenant Christophers to conclude that minute trace of copper would be readily and quickly precipitated, and so rendered inert, in the case of water containing much organic or even inorganic material in solution. From experiments to test the action of copper sulphate on pure water Lieutenant Christophers made the two following important deductions: —(1) That the action of storing water in clean copper vessels does not appear to cause anything approaching sterile conditions ; and (2) that one part of copper sulphate in ten thousand parts of water has a sterilising effect upon typhoid bacilli. The experiment to test the action of copper sulphate in the presence of organic matter in solution, *i.e.*, 1 to 200 and 1 to 400, showed that copper sulphate in a highly organic solution had a marked inhibitory effect upon the growth of the typhoid bacillus ; but a copper sulphate solution of 1 in 250 did not destroy in four hours all the bacilli in organic matter of the kind experimented with.

To sum up Lieutenant Christophers said that as a disinfectant in the ordinary sense of the term copper sulphate does not seem to be very efficient ; and that the experiments carried out did not on the one hand necessarily assign marvallous or astounding properties to copper salts in the disinfection of water. On the other hand he says that the experiments should not be taken as necessarilly showing the full extent to which copper especially as an alga-growing inhibitor, might in certain cases be used. On the whole the experiments served to show, Lieutenant Christophers says, "that the claims for copper salts rest upon a basis of actual experiment ; but further research and in the case of alga destruction, practical application are needed before the more extraordinary possibilities suggested for the use of copper salts can be established."—*Madras Mail.*

REMARKABLE DISCOVERY SCIENTIFIC WORKS IN SANSKRIT.

Time has now arrived when men of culture should give up the long-lingering impresson that there are no Sanskrit works on Botany, Geology, Mycology and Entomology—subjects now read in India in the English language alone. The following facts will go to show that there are various scientific works in Sanskrit. The other day, a meeting of selected friends was held in the house of Doctor Srinivasa Row M.A., at Basavanagudi, Bangalore City; there was present one Bralima Sri Subbramanya Sastriar of Anekal, to whom the learned Doctor put several questions on Botany which were answered by quotations of Sanskrit Slokas and then and there explained in the vernacular. These correct answers so happily coincided with English Botany, that further questions were put on Geology. Hundreds of Slokas were repeated one after another as answers. The method of exploring, the description of the locality where Gold, Silver, Iron, Steel, Copper, Diamonds and other precious stones are found, the under-ground chemical processes of their formation were explained in simple and yet clear Sanskrit Slokas for one full hour. Then questions on the causes of the decline of plants and trees, sandalwood in particular, were put. After these were explained in full remedies of various kinds so that we were simply startled to find that Slokas were on the tip of his tongue. The Pundit then went on enlightening the audience on Surgery and manufacture of different kinds of Engines that are now found in Europe. He was quite willing to dictate from the manuscripts he had with him Slokas on any branch of Science. I greatly regret that this noble relic has been allowed to remain in the dark purely for want of patriotic men in Mysore. One naturally thought of Bengal where patriotism is considered universally to be the highest virtue. The students and masters of the Western Science may avail themselves of this opportunity to get the manuscripts copied out and printed and it will prove a meritorious service to Indians. Mr. Subbramania Sastriar is a native of Anekal, a Taluk Head-quarters attached to the Bangalore District, about 25 miles from Bangalore city. One Mr. Seetaramiah, pleader, Bangalore city, may be addressed in the matter. It is this philanthropic gentleman with whom the famous Sastriar is often found.

PAPER COTTON STALK.

The manufacture of paper from the fibre of the cotton stalk is one of the latest inventions which are said to have passed the experimental stage. It is asserted (says "The World's Work") that all grades of paper, from the best form of linen to the lowest grade, can be manufactured from cotton stalks. In addition to this, a variety of byproducts, such as alcohol, nitrogen, material for guncotton and smokeless powder can also be secured in paying quantities. Mills for the use of cotton stalks in that way may become general in the cotton-growing States. It is estimated that on an area of land producing a bale of cotton at least one ton of stalks can be gathered. Upon this basis, from 10,000,000 to 12,000,000 tons of raw material could be secured for the production of paper, which would increase the value of the cotton crops of the Southern States nearly £2,000,000.